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THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY,

INCLUDING

ZOOLOGY, BOTANY, AND GEOLOGY.

(BEING A CONTINUATION OF THE 'ANNALS' COMBINED WITH LOUDON AND CHARLESWORTH'S 'MAGAZINE OF NATURAL HISTORY.')

CONDUCTED BY

CHARLES C. BABINGTON, Esq., M.A., F.R.S., F.L.S., F.G.S.,
JOHN EDWARD GRAY, Ph.D., F.R.S., F.L.S., V.P.Z.S. &c.,
WILLIAM S. DALLAS, F.L.S.,
AND
WILLIAM FRANCIS, Ph.D., F.L.S.

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1868.

"Omnes res creatæ sunt divinæ sapientiæ et potentiæ testes, divitiæ felicitatis humanæ:—ex harum usu *bonitas* Creatoris; ex pulchritudine *sapientia* Domini; ex œconomiâ in conservatione, proportione, renovatione, *potentia* majestatis elucet. Earum itaque indagatio ab hominibus sibi relictis semper æstimata; à verè eruditis et sapientibus semper exculta; malè doctis et barbaris semper inimica fuit."—LINNÆUS.

"Quel que soit le principe de la vie animale, il ne faut qu'ouvrir les yeux pour voir qu'elle est le chef-d'œuvre de la Toute-puissance, et le but auquel se rapportent toutes ses opérations."—BRUCKNER, *Théorie du Système Animal*, Leyden, 1767.

. The sylvan powers
Obey our summons; from their deepest dells
The Dryads come, and throw their garlands wild
And odorous branches at our feet; the Nymphs
That press with nimble step the mountain-thyme
And purple heath-flower come not empty-handed,
But scatter round ten thousand forms minute
Of velvet moss or lichen, torn from rock
Or rifted oak or cavern deep: the Naiads too
Quit their loved native stream, from whose smooth face
They crop the lily, and each sedge and rush
That drinks the rippling tide: the frozen poles,
Where peril waits the bold adventurer's tread,
The burning sands of Borneo and Cayenne,
All, all to us unlock their secret stores
And pay their cheerful tribute.

J. TAYLOR, *Norwich*, 1818.



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THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[FOURTH SERIES.]

Rhode Island Historical Society

"..... per litora spargite muscum,
Naiades, et circùm vitreos considite fontes:
Pollice virgineo teneros hìc carpite flores:
Floribus et pictum, divæ, replete canistrum.
At vos, o Nymphæ Craterides, ite sub undas;
Ite, recurvato variata corallia trunco
Vellite muscosis e rupibus, et mihi conchas
Ferte, Deæ pelagi, et pingui conchylia succo."
N. Parthenii Giannettasii Ecl. 1.

No. 7. JULY 1868.

I.—*Monograph of* Spirifer cuspidatus (Syringothyris cuspidata), *Martin*. By Professor W. King.

[Plates II. & III.]

Two special memoirs on this species have lately appeared—one by Dr. Carpenter, published in the 'Annals and Mag. of Nat. Hist.' for last July, and the other by Mr. Davidson, which is inserted in the 'Geological Magazine' of the same month. The latter gives an account of some important discoveries recently made by different palæontologists on this and other related species; while the former is chiefly taken up with a description of Dr. Carpenter's own investigations on its internal and histological features.

Dr. Carpenter's investigations have led him to adopt a somewhat novel conclusion, that "there is an exact isomorph of *Spirifer cuspidatus*, not distinguishable from it by external conformation, but generically differentiated by a very marked peculiarity of internal structure" (viz. dental plates connected by a transverse canaliferous septum) and a "patchy perforated shell-tissue."

Notwithstanding that Dr. Carpenter upholds in the strongest manner his conclusion as an "incontestably established fact," I venture to give my reasons for believing that the fossils

which he has "transferred" to the so-called "isomorph" are neither "generically" nor specifically "differentiated" from the species under consideration, that, histologically and internally, the perforated and canaliferous specimens are identical with those stated to be "imperforate" and without the septum.

External Conformation.

Few Palliobranchs have so singular an appearance as *Spirifer cuspidatus*. While its spiriferal valve deviates in no marked degree from ordinary species, being semielliptical and flatly convex, its opposite one is characterized by an erect elevated umbone and an enormously developed area, which give quite a pyramidal form to the shell.

Instead of being incurved, as is usual, the umbone displays more tendency to the opposite character, or to become twisted, like that of *Streptorhynchus*. The area varies in outline between an equilateral and an acute isosceles triangle, and, as in most Spirifers, it is both transversely and longitudinally marked with faint lines. The deltoid fissure is well exhibited; but whether it was closed in all its length with a deltidium, as is the case in the allied *Sp. distans*, Sowerby, or merely in its lower part, is a point which I am unable to determine. I have represented in Pl. II. fig. 1 a specimen of *Sp. cuspidatus* presented to the Geological Museum of Queen's College, Galway, by my very respected colleague, Dr. M'Coy, Professor of Materia Medica, which shows, what is rarely exhibited, the deltoid fissure near its base covered with a number of arching lamellæ; but nothing of the kind occurs higher up: so there is just as much reason for concluding that the upper part has been destroyed as that it never existed. If, as appears to be the case, the semicircular space below the arching lamellæ has served as a foramen or opening for the pedicle, the circumstance would afford some ground in favour of the first conclusion*, and consequently of the species being furnished with a deltidium like that of *Sp. distans*†.

Both valves are marked with numerous fine ribs, which, however, occasionally become obsolete; and this is generally the case on the median folds.

* I would suggest to American palæontologists who have an opportunity of collecting casts of apparently this species, abundant in the Carboniferous sandstone in the State of Ohio, to examine impressions of the area, when, no doubt, they will be able to determine whether the deltoid fissure is partially or completely closed.

† Several of Mr. Davidson's figures represent specimens of this species with the deltoid fissure completely closed. (See Mon. Brit. Carb. Brach. pl. 8, and Geol. Mag. July 1867, pl. 14. figs. 7 & 9.)

Histology.

In his Report "On the Microscopic Structure of Shells," published in the Brit. Assoc. Report, 1844 (p. 18), Dr. Carpenter states that perforations "are absent in *Spirifer cuspidatus*." Some years afterwards, previously to 1850, my attention was directed to this point; but, from the appearances which I observed on a specimen, by means of a Coddington lens, I was led, with respect to the above statement, to "suspect" that it had been made through "an oversight"*. Subsequently, apparently in 1852, Dr. Carpenter, again referring to this and another species, stated he was "fully satisfied that in neither do any perforations exist"†.

Two or three years ago, Mr. Meek, while examining a collection of American specimens related to or identical with *Spirifer cuspidatus*, also a specimen of this species from Millicent, in Ireland, detected, "with a good pocket lens, some evidence" of the former having "a punctate structure"—a point which he afterwards put "beyond doubt" by "placing fragments of the shell under a high magnifier, where they could be examined by transmitted light." The Millicent specimen "also was quite unexpectedly found to be *clearly punctate*, like the American forms"‡.

The announcement of Mr. Meek's discovery brought out a letter from Dr. Carpenter, who expressed himself as having "read" it with "much surprise." The letter mentions that Dr. Carpenter had examined his "original Bristol sections," also "chips of specimens from six different localities," "in not one" of which" is there the smallest trace of perforations, though the structure of the shell is well preserved in every instance"§.

I have now arrived at an important stage in the history of the discovery of the true histological characters of the species under consideration.

The reasons for my *suspicion* were stated in the 'Geological Magazine,' published in June last. In the succeeding month, Dr. Carpenter, after having "confidently affirmed" the results of his second investigation, as above stated, publishes a paper in which the following points are made known:—Out of *four* Irish specimens examined, *three* were found to be "indubitably perforated," and the perforations had a "*patchy* distribution;"

* Monograph of Permian Fossils of England, p. 126.

† "On the Intimate Structure of the Shells of the Brachiopoda," in Davidson's Monograph of British Fossil Brachiopoda, Introduction, p. 34.

‡ Proc. Acad. Nat. Sc. Philadelphia, Dec. 1865, pp. 275, 276.

§ Annals & Mag. Nat. Hist. January 1867, p. 30.

the exceptional specimen from Millicent, on the contrary, exhibited "*not the smallest trace of perforations.*" Moreover, by "slicing across" the umbonal region of one of the specimens, it was found to contain the canaliferous septum already spoken of; but on making a similar slice in the "imperforate" or exceptional specimen, "no vestige whatever" of the septum was seen*.

It cannot be too strongly impressed on the reader that, in his examinations in 1844 and 1852, Dr. Carpenter was unable to detect any perforations in *Spirifer cuspidatus*, that in January 1867, having gone over a number of "chips of specimens from six different localities," including his "original Bristol sections," which were submitted to a "careful examination," there was "not one" showing the "smallest trace of perforations;" whereas, in his late and fourth series of investigations, *all* the new sections and chips from Irish specimens, with only one exception, were found "unquestionably exhibiting *patchy* perforations." It must also be borne in mind that Dr. Carpenter, noticing other "two Millicent specimens," examined by him on the last occasion, admits that he "might not have ascertained the existence of perforations in them, had not every lamella of the shell that could be scaled off been carefully scrutinized" (*loc. cit.* p. 71).

Now, considering the different results obtained, the paucity of evidences of the kind really needed, and the difficulty in ascertaining the true histological characters of certain specimens, I feel convinced that few of such "palæontologists as pay special attention to the Brachiopoda" would have so hastily adopted the conclusion with which Dr. Carpenter has identified himself.

It is to be regretted that neither Mr. Meek nor Dr. Carpenter has published a representation of the perforations†. Mr. Meek describes them as being "very small, scattering, and not arranged with the regularity seen in most types of *Terebratulidæ*, or in *Cyrtina*, *Spiriferinæ*, &c.,"—also "so distant that fragments large enough to show clearly the punctures as seen in the various types of Terebratulidæ might be without a

* 'Annals,' July 1867, pp. 69–72.

† It appears, however, from a letter which I have received from Mr. Meek, that he had an intention of publishing a paper, with illustrations, on the subject; but after Dr. Carpenter had acknowledged the accuracy of his conclusions, he decided not to publish it. Mr. Meek has kindly favoured me with two of his drawings, which have been of much service to me in my present investigations. Considering the careful attention he has paid to the perforations of *Spirifer cuspidatus*, and the opportunity he appears to have of examining various allied species, I would strongly urge him not to relinquish entirely his intention.

single puncture"*. And Dr. Carpenter, noticing "the type specimen of Prof. Winchell's *Syringothyris*," describes the perforations in a similar manner. "They are not distributed, however, with the uniformity which usually prevails in the shells of the perforated Brachiopoda; for patches of imperforate shell intervene between portions that are pretty regularly perforated, and sometimes a fragment large enough to fill a great part of the field of view is entirely imperforate"†.

Owing to the great importance which attaches to the perforated character of *Spirifer cuspidatus*, I have taken upon myself the labour of preparing a number of sections, made parallel to the surface of the valve, and taken from various specimens of this and other species. I shall now proceed to detail the result of my examination, which has generally been made with object-glasses magnifying from 60 to 120 diameters.

No. 1.—Specimen from near Tuam, presented to the Geological Museum of Queen's College, Galway, by Mr. Birmingham, and noticed in my former paper‡.

Six sections, easily rubbed down, were prepared: they show the test distinctly formed of long, slender, flattened, subtranslucent fibres, running straight or winding about most irregularly. Interspersed among the fibres, in most of the sections, occur a number of spots, undoubtedly transverse sections of tubular perforations, which, varying in size, have in general a diameter about equal to the width of two fibres. (See fig. 2.) Dr. Rowney§, who has measured the perforations, states that, though often smaller, they rarely exceed $\frac{1}{1000}$ inch in diameter: they have a rude linear or quincuncial arrangement, and are from $\frac{1}{1000}$ to $\frac{1}{500}$ inch apart from one another‖. They are filled with a granular substance, in some cases quite dark-coloured, generally lightish brown, and often very pale; between one extreme and the other there are intermediate shades

* Proc. Acad. Nat. Sc. Philadelphia, Dec. 1865, p. 277.

† Ann. & Mag. Nat. Hist. July 1867, p. 71.

‡ Geological Magazine, June 1867.

§ I must not forget to acknowledge the great assistance my colleague has afforded me in my histological researches in connexion with the various specimens I have had under examination.

‖ Dr. Carpenter, who has only given the size of the perforations as they occur in "Professor Winchell's type specimen," states that they are "about 1-3000th of an inch in diameter," and "set at an average distance of about 1-300th of an inch from each other." Compared with the perforations in other Palliobranchs, those of *Spirifer cuspidatus* are evidently very minute. In *Kingena lima*, a cretaceous species, whose perforations, according to Dr. Carpenter, "are smaller than those of any *Terebratula*, recent or fossil, their diameter is scarcely 1-2000th of an inch." (Introduction to Davidson's Monograph, p. 28.)

of colour. Very few of them present a definite form, their outer portion being generally irregular and lightest in colour, shading off into the subtranslucency of the surrounding fibres*. It is extremely rare to see the perforations pushing the fibres aside; the latter pursue their course, as it were, with very seldom any appearance of being forced either to the right or the left by the former. When the perforations are pale, it is only by their being slightly less translucent than the fibres that their presence can be with safety determined. Frequently there are breaks in the lines of perforations; and spaces, appearing to be imperforate, lie next to others undoubtedly perforated. In two of the sections no perforations are seen, except perhaps what might be considered to be, in two or three cases, the faintest traces of them.

Whatever be the cause of the absence of the perforations in the preceding sections, the following additional points ought not to be overlooked in considering this question:—(1) The perforations often appear as if they stopped short of one of the surfaces of the sections. (2) The sections often exhibit what *appear* to be very minute perforations intermixed with the ordinary-sized ones. (3) I have occasionally seen two fibres appear as if crossing the transverse section of the perforations, where the latter are faint. These points, and the indefinite outline of the perforations, the little or no deviation they produce in the ordinary course of the fibres, also their "*patchy* distribution" (in which the sections agree with those examined by Meek and Carpenter), certainly do not ordinarily prevail among perforated Palliobranchs, at least in recent species and others, occurring in Tertiary and Secondary rocks, which have undergone no metamorphism.

It may now be mentioned that I "suspected" *Spirifer cuspidatus* to be perforated, from "*patches* of faint, slightly raised, oval impressions" being "present on the subsurface shell-layers" of Mr. Birmingham's specimen—and that I expressed an opinion of the "impressions" being each caused by the rising-up of the fibres around a perforation, such as takes place in *Waldheimia australis* and other recent species†. This relationship between the impressions and the perforations is proved by the evidences illustrated in Pl. II. Fig. 4 represents the

* According to one of Mr. Meek's drawings, the perforations, as seen in a variety, or an allied species (*Sp. subcuspidatus*), are distinctly defined—so much so that Mr. Meek informs me that he has "in some instances had under the microscope a single isolated fibre with half the diameter of a perforation cut out on one side (shown in Pl. III. fig. 3), as illustrated by Carpenter in some of his publications."

† Geological Magazine, June 1867.

impressions as they appear when magnified twenty diameters; and fig. 5 shows the *perforations* similarly enlarged, precisely in the order, and at the distance from one another, to make the impressions answer to the centres of the perforations.

It is also of some importance that the appearances which I took for perforations are stated in my paper to occur "here and there" in "patches"—a statement *completely corroborated* by Dr. Carpenter himself, and singularly agreeing with his remark, applicable to all the perforated specimens he has examined, that the perforations have a "patchy distribution."

No. 2.—This specimen has been kindly lent to me by Mr. Morton, F.G.S. &c., of Liverpool. Its locality is not known: possibly it is from the west of Ireland.

Four sections, all showing perforations, most of them agreeing with those of No. 1, except that they are in general larger, which appears to have been caused by metamorphism. In one section they are quite distinct, but in the others they are more or less obscure. The perforations in the best section have a dark granular infilling; and generally they have an indefinite outline; the darkest are the best defined. In two of the sections the contents of the perforations are for the most part pale and subtranslucent; and the perforations themselves are each surrounded by a broadish encircling zone of what appear to be granules or cellules, though the appearance seems to be due to the ends of the fibres rising up around the perforations. In one section the perforations have lost all characters as such, each being unusually large (larger than those above referred to), and appearing as if it were a mere aggregation of transparent cellules or granules (fig. 6). In most of the sections the fibres are subtranslucent and well displayed: they run straight on or wind about, but sweep past the perforations with scarcely any deviation. The sections were easily rubbed down.

No. 3.—Specimen presented by Dr. M'Coy. It is the one represented under fig. 1.

Of six sections, one shows no distinct perforations; perhaps one or two slightly opaque spots might be taken for them: two others show something of the kind somewhat more obscurely, but more numerously: in the fourth they are somewhat less obscure, and, besides varying much in size, they are "scattering." The other sections are even less satisfactory. The fibres are quite distinct.

No. 4.—I succeeded in getting no more than three sections from this specimen: only one of them shows what may be perforations, of a light-brown colour, but no better than the less "obscure ones" in a section belonging to the last speci-

men, though they are arranged somewhat more regularly. Fibres well displayed.

No. 5.—Six sections: none showing decidedly any perforations; a few faint markings, almost as translucent as the fibres, may, I suspect, represent them. The fibres, straight and twisting, are very well displayed.

No. 6.—Specimen presented by Professor Harkness. I have prepared twenty sections (some very thin) taken from all parts —sides, median fold, and area. They were not so easily rubbed down as those from Messrs. Birmingham and Morton's specimens. Most of the sections exhibit the fibres, beautifully translucent, running straight out or winding about, and strikingly resembling those of the recent *Rhynchonella psittacea*. Not one shows anything that could be pronounced to be a perforation; but, as usual, obscure markings are present. The subshell-layers display, in places, slightly raised oval impressions, the same as those seen in Mr. Birmingham's specimen.

It is important to observe that *every one* of the previous specimens is *undoubtedly furnished*, as will be seen hereafter, with the *canaliferous septum*.

No. 7.—This specimen is small, and appears to be a dwarfed individual, judging from the unusual thickness of its valves. It is from Millicent, and is the original of fig. 19, pl. 8, of Mr. Davidson's 'Carboniferous Brachiopoda.' Dr. Carpenter, who has cut the specimen through its umbonal portion, "feels" himself "justified in confidently asserting that it is essentially imperforate." He has given a representation of a "transverse section" of its umbone to show that the "dental laminæ are unconnected by any transverse septum, and that there is no vestige whatever of the canal"*. On the latter point some considerations favouring a different view will hereafter be produced. Mr. Davidson has, in the most liberal manner, presented me with the two halves, left after Dr. Carpenter had cut the specimen, to operate upon, as I thought fit, for the benefit of science.

Twelve sections were obtained, all hard and imperforate, like those of the last specimen. Indeed the sections from both are perfectly identical, not only in the absence of perforations, but in the distinctness, disposition, and translucency of the fibres.

That this specimen "exhibited not the smallest trace of perforations" to Dr. Carpenter is quite admissible. It is necessary, however, to state that one of my sections shows a few scattered spots, which approach to some of the obscure markings noted as occurring in the precited sections of perforated

* Ann. & Mag. Nat. Hist. July 1867, p. 72, fig. 4.

specimens, and supposed to be the remains of perforations. This and other considerations prevent me from admitting that Mr. Davidson's specimen was always imperforate—that is, that it absolutely possesses or possessed this negative character.

It will have been seen that, with the exception of the last three specimens, all the rest show *perforations* more or less plainly, but associated with others which exist in a very obscure condition—so much so that, were it not for their occurring in the required place, and being slightly different in translucency, they might be objected to as representing anything of the kind: between the latter and the former, however, there indisputably occur all the intergraduating forms. Moreover perforations often unexpectedly appear in the midst of wide imperforate spaces—a fact admitted both by Mr. Meek and Dr. Carpenter.

Now, as the perforations of *Spirifer cuspidatus* occur in all states of appearance, from the extreme obscure to the perfectly obvious, is it not reasonable to suppose that they may also occur under such conditions as to be imperceptible, and thus give rise to seemingly "imperforate spaces?" Why the perforations are partially absent in some specimens, also totally absent in others—I do not feel myself competent to go beyond suggesting that the cause may be in some way or other connected with the metamorphism or mineralization of the test. But Dr. Carpenter declares himself to be strongly in favour of a different view. He "feels certain" that the absence of the perforations "is not the result of any alteration produced by fossilization, the shell-structure being equally well preserved in the perforated and in the imperforate parts"*. The statement may be taken for a fact; but I totally dissent from the conclusion drawn from it. A few observations on this point may now be brought forward.

The fact mentioned by Dr. Carpenter is certainly a remarkable one. It, however, not only holds good in the "perforated" and "imperforate parts," but equally so in those which show the *perforations very obscurely*. The present condition of such perforations is indisputably "the result of alteration;" yet how does it happen that their associated fibres are "equally well preserved" as in the other cases? Because, from certain incidental causes and structural peculiarities, to be shortly noticed, "fossilization" has had the effect of (*nearly* in many cases and *entirely* in others) obliterating the perforations, without producing any such results in the "shell-structure." The existence of the cases just referred to is not to be taken simply

* Ann. & Mag. Nat. Hist. July 1867, p. 71.

on my authority. Dr. Carpenter has not alluded to them; but they are attested by Mr. Meek, who states that "where the perforations happen, as is often the case, to be filled with matter of the same colour and translucency as the fibres composing the shell, it is exceedingly difficult to see them"*.

It is now necessary to refer more particularly to a point already mentioned, viz. that the *imperforate* specimens have a higher degree of hardness than the perforated. The circumstance will be accepted by any mineralogist as showing that the substance of the former is in a different condition from that of the latter. In both cases, however, the substance is carbonate of lime: it may therefore be concluded that the softest or perforated specimens are composed of this compound in its ordinary state, *i. e.* calcite, and the hardest or imperforate ones in the dimorphic state of arragonite. Still the question requires to be answered—why is it that the fibrous tissue is preserved, and that the perforations are obliterated?

In the course of my present investigations I have repeatedly traced the perforations passing by degrees into obscureness—their opacity insensibly melting into a translucency approaching that of the fibres, and their indefinite outline gradually becoming still more indefinite. Between either of the last states and total obscurity on the one hand, or complete indefiniteness on the other, I have not been able to trace the perforations with any satisfaction. But numerous translucent spots, large and small, may often be observed. It is the number of these spots that makes the investigation at this stage so unsatisfactory; nevertheless there is nothing to oppose the idea that the largest of them represent the perforations, and that the smallest are cross sections of individual fibres, or bundles of them, which have curved off from the general plane to which they belong.

Moreover in perforated specimens the fibres are composed of an *amorphous translucent* substance, and the contents of the perforations of *granular opaque* matter, both structures most probably consisting of carbonate of lime. The reason of the perforations being obvious in such specimens requires no explanation. Assuming, however, the existence of specimens with both the fibres and the contents of the perforations changed into amorphous *translucent* arragonite, is not such a condition the very one to render it impossible for the perforations (so *small* and *indefinite* as they are in *Spirifer cuspidatus*) to be distinguished from the fibres?

But, whatever way the question under consideration is to be

* Proc. Acad. Nat. Sc. Philadelphia, Dec. 1865, p. 277.

settled, there can be no doubt that the phenomenon sought to be explained is the result of metamorphism; and I hold this to be completely proved by the fact that in metamorphosed examples of the tests of other Palliobranchs the perforations disappear just as they do in *Spirifer cuspidatus*. Of various shells which I have examined, such as *Dielasma* (*Terebratula*) *hastata*, *Pygope diphya*, &c., I may confine myself to *Spiriferina laminosa**, M'Coy, which has afforded me the clearest evidence in favour of the above conclusion. The latter species occurs in various conditions of fossilization: some of my specimens have the test well preserved, others have it completely destroyed, and many have it in an intermediate condition. The best-preserved specimens (for which I am indebted to Mr. G. Tate, F.G.S., of Alnwick) that have passed under my examination are from Redesdale, in Northumberland. The fibres are well displayed, twisting about more or less, and separating or pushed aside by the intrusion of the perforations. In general the perforations are well defined, so that their diameter, which is $\frac{1}{750}$ inch, can be tolerably well determined. They occur pretty regularly at about $\frac{1}{200}$ inch from one another; but occasionally a smaller perforation makes its appearance in the intermediate spaces: their contents consist of translucent granules, a dark-coloured matter, or a dusky-white substance. Under a magnifying-power of 120 diameters, the dark-coloured matter resolves itself into a congeries of crystals of pyrites. Here and there a section appears without any perforations; or some present themselves more or less obscurely, either as ill-defined aggregations of granules or indefinite dusky spots; the former are occasionally somewhat enlarged. From the less clear appearance of the fibres in such places, the absence or the obscurity of the perforations is evidently due to a change in the shell-tissue. It is noteworthy that the fibres, where mere traces of the perforations occur, occasionally display only faint or uncertain indications of their deflection; rather they appear to continue straight on in their course. Specimens which I have examined from other localities differ remarkably from those collected at Redesdale. Mr. W. H. Baily, Palæontologist to the Irish Geological Survey, has favoured me with some from Hook Point and Tipperary; but they are all so completely silicified that nothing more than the fibrous structure is retained. I have also succeeded in obtain-

* Mr. Davidson and others have placed this species in *Spirifer*; but it undoubtedly belongs to *Spiriferina*. All the localities from which I have examined specimens have yielded me dorsal valves of it with the mediolongitudinal plate characteristic of the latter genus.

ing some large specimens from the neighbourhood of Galway*, of which the outer layer is completely silicified, exhibiting, as a consequence, merely the mineral structure (siliceous pins enclosed in cylinders) characteristic of palliobranchiate shells in the metamorphosed condition; on the contrary, the inner and much thicker layer consists of a greenish substance, which, from effervescing on the application of acid, and being somewhat harder than calcite, may be considered to be arragonite All the sections I have made of the latter layer display the fibres more or less clearly; but none of them exhibit the perforations at all well; and these structures are very often altogether absent. In their most obvious condition the perforations, or, speaking more precisely, their vestiges, appear as dusky spots, or aggregations of granules, which have a translucency more or less approaching that of the fibres: both kinds are ill-defined; and the latter are occasionally larger than the former. The fibres agree with those of the Redesdale specimens in undulating and parting asunder where the traces of perforations make their appearance (see figure 7). In many cases little more than mere openings in the fibres are the only evidences of a perforated structure; and often, as in the Redesdale specimens, even such indications have been obliterated, the fibres running on without any strongly marked deviation from parallelism†.

The histology of *Spiriferina laminosa*, and the changes it has undergone, bear a strong resemblance to what have been pointed out in *Spirifer cuspidatus*, with this difference: the perforations are much the smallest in the latter species, and the fibres are not separated by their intrusion. But had the perforations of *Sp. cuspidatus* been of the ordinary size, there can be no doubt the imperforate *spaces*, and *specimens*, would have exhibited indications of them in the occasional opening out of their fibres where they have been present. Mr. Meek has supplied me with a piece of evidence which explains, as is equally the case with similar evidences furnished by Nos. 1 & 2 specimens, the absence of such traces of a perforated structure on the view I have advanced. He informs me that "in some instances" [the expression shows how exceptional they are]

* The Irish specimens, which are larger than those I have examined from Redesdale, have often two more obscure ribs on the terminal point of each wing: the latter do not appear to have been individuals of such free growth as those found in Ireland.

† Siliceous pins occasionally occur in the fibrous inner layer; but they break through the fibres without causing them to part asunder: the latter terminate abruptly against the former, as is the case with the *enlarged* perforations in Mr. Morton's specimen of *Sp. cuspidatus* (see fig. 6).

"the fibres could be clearly seen on each side of a perforation *deflected slightly* to one side in passing as it were around it."

Reverting to *Spiriferina laminosa*, it cannot now for a moment be questioned that the changes which its shell-tissue, in the Irish specimens, have undergone are caused by metamorphism. Is it right, then, to reject the same agent in *Spirifer cuspidatus*, because in this species (I contend, on account of the unusually small size of the perforations) the evidences of its action in a certain stage cannot be absolutely accepted as demonstrated?

Impressed with the preceding evidences and considerations, I can only conclude that, wherever imperforate *spaces* occur in *Spirifer cuspidatus*, perforations were originally present in them. And although Mr. Davidson's specimen (also, it must be remembered, Prof. Harkness's) may be noted as "exhibiting not the smallest trace of perforations," I have no hesitation whatever in adopting the same simple conclusion in this case as well, rather than seek for its explanation in any strange morphological doctrine.

Apophysary System.

It has long been known that various Spiriferids are furnished with a pair of dental plates, differently modified according to species; but it is not so well known that many of them have these parts united so as to form an apophysis more or less resembling the arch-shaped chamber characteristic of *Pentamerus*, *Stricklandinia*, and *Camarophoria*, though in many species its exact homology with the latter appears very doubtful. In a number of the cases to which reference is made, the apophysis, as will shortly be seen, is so small, or so obscured by a deposit of shelly matter between its outer surface and the inside of the umbonal cavity, as to render its individuality difficult to make out, causing it to appear, in the latter case, like a depression excavated in the substance of the umbone.

Professor Phillips appears to have been the first who detected the process in the Spiriferids; for in his description, published in 1835, of *Spirifer septosus*, this species is stated to have "the septa in the lower valve dividing it into three parts, as in *Pentamerus*"*. It is now well known, through Davidson's careful labours and excellent figures, that the species above named has the dental plates curving inwardly towards each other, and then uniting, so as to form a complete arch. The plates, which do not separate again, as in a number of Spirifers, remain united, producing a well developed

* Geology of Yorkshire, vol. ii. p. 216.

median plate, extending from the crown of the arch to the inner surface of the pertaining valve*.

Possibly the process was next discovered in *Spirifer cuspidatus* by M. Deshayes, though I admit that his description of what may be taken for it, in his general observations on the species, is not so clearly to the point as could be desired†.

As stated in my last communication to the 'Geological Magazine,' I made known, in 1846, that *Spirifer heteroclitus* (now *Cyrtina heteroclita*) has an arch-shaped process supported by a median plate. It also fell to my lot to show, in 1850, that a similar structure occurs in a typical *Spirifer*, the Permian *Sp. alatus*, Schl. My diagnosis of this species states that its "dental plates are small, curving, and coalescing;" and I mentioned, in the general observations, that they "have an unusual form, being small, curving, and coalescing at their upper part, so as to become arch-shaped"‡. As the original figure which I gave of this structure is not sufficiently clear, in consequence of its representing a portion of the matrix, a fresh drawing is given of the apophysis, in Pl. III. fig. 8; I have also represented a transverse section of the same part in fig. 9, as exposed by grinding down the umbone of the large valve. It will be seen that the process is formed by the dental plates, *b*, curving in towards each other, and by the deposition of shelly matter, *c*, between them. Although the latter fills up the umbonal cavity to a great extent, which is not the case in a number of other Spirifers, the dental plates are still discernible, passing on and becoming attached to the inner surface of the pertaining valve.

There are some grounds for supposing that Prof. M'Coy has observed the apophysis in *Spirifer cuspidatus*. He described, in 1855, the large valve as possessing a "triangular opening very large, often displaying the *internal deep-seated pseudo-deltidium* (without perforation, leaving the only opening to the shell at its base)"§. Mr. Meek appears to take the structure I have italicized for the transverse septum‖; but

* Mr. Davidson places *Spirifer septosus* in his genus *Cyrtina*. He appears to have overlooked the question put in my former communication as to the type of this genus.

† See Lamarck's 'Animaux sans Vertèbres,' 2nd ed. vol. vii. p. 368 (1836). Deshayes, referring to the area, states that it "est traversée dans toute sa hauteur par une gouttière triangulaire; si la matière dure de la couche qui la remplit ordinairement a été enlevée, on trouve cette gouttière fermée dans presque toute son étendue, et offrant, vers le sommet, un trou ovalaire, de sorte que cette coquille, malgré l'étrangeté de sa forme, a en effet les caractères des Térébratules."

‡ Precited Monograph, p. 131.

§ British Palæozoic Fossils, p. 426.

‖ Proc. Acad. Nat. Sc. Philadelphia, Dec. 1865, p. 277.

M'Coy, in his description of the genus *Spirifer*, having invested the perforated or "receiving valve with an *internal* pseudo-deltidium"* (an expression not very clear), it is somewhat uncertain that such is the correct view.

Professor de Koninck was the next to discover the process, having in 1859 described it as occurring in *Spirifer distans*, Sowerby†, a species closely allied to *Sp. cuspidatus*. I have succeeded in exposing a section of it, represented in fig. 10, as disclosed in a specimen collected by myself some years ago, near Derrybrian, about twenty miles south-east of Galway, where it characterizes the Lower Carboniferous shales. The process corresponds with that represented by De Koninck, and more fully illustrated in Davidson's precited communication, in having a projecting canal or "*incomplete tube*" along the median line of the back of the "transverse septum."

I must now dwell more particularly on the last-mentioned feature. Prof. Winchell described it, in 1863‡, as occurring in an American form which I consider to be identical with *Spirifer cuspidatus*, also in *Sp. granulifer*. Whether he was the first to detect the transverse septum may be considered uncertain, seeing that Deshayes and M'Coy have noticed something which may be the same; but this appears certain: he was the first to determine the existence of the "incomplete tube." Winchell, believing the shell (the first one above alluded to) to be an undescribed species, and generically differentiated from all others in being furnished with a peculiar apophysary system, was induced to regard it as the *type* of a new genus: hence his name *Syringothyris typa*.

In 1865 Mr. Meek extended the discoveries of Prof. Winchell by finding the appendage in other American shells allied to *Sp. cuspidatus*, also in specimens of this species from Millicent.

Prof. James Hall has observed it in some others. In his fourth volume of the 'Palæontology of New York,' lately published, he mentions that *Spirifer altus* has the septum but not the tube, and that in *Sp. textus* both parts occur associated as in *Sp. cuspidatus*§.

The discoveries by Dr. Carpenter, already mentioned, are the latest that have appeared in connexion with the subject.

I may now proceed to give an account of my own investigations.

* Brit. Pal. Foss. p. 191.

† Mém. de la Soc. Roy. des Sc. de Liége, 1859.

‡ Proc. Acad. Nat. Sc. Philadelphia, January 1863.

§ I have derived this information from extracts, taken from Professor J. Hall's new volume, in Mr. Davidson's recent article in the 'Geological Magazine,' July 1867.

Beginning with *Spirifer cuspidatus*, I am enabled to give, in Pl. II. fig. 11, a representation of a specimen (the one already noticed as belonging to Mr. Morton, F.G.S. &c.) which shows the inside of the arch, with the dental plates, free from the infilling of foreign matter which generally conceals it. The arch extends for about two-thirds of the length of the deltoid fissure, gradually rising from its origin at the apex of the umbone to its free extremity, where it is nearly a quarter of an inch in height: in the centre of the margin of the arch there is a slight projection, which corresponds to the termination of the canal, as shown in Winchell's figure of his so-called *Syringothyris typa**. Owing to the arch and the median fold or sinus of the pertaining valve passing so far into the cavity of the shell, a comparatively small space, necessarily, intervenes for the animal.

By grinding down the umbone of the large valve of a number of specimens, I have succeeded in finding the apophysis *in every one* of them. The canal and septum vary in different specimens, even in the same individual. Occasionally the canal is enclosed in the septum, the middle of which is enlarged by it (fig. 12, Pl. III.: this belongs to No. 3 specimen). It also occurs attached to the outer or upper side of the septum (fig. 13, No. 4 sp.); or it projects from the inner or under side (fig. 15, No. 5 sp.). Generally the septum is concave to the plane of the area (fig. 13); occasionally it is parallel with (fig. 12), or convex to it (fig. 15).

The fullest information respecting the canaliferous septum has been revealed to me by operating on Professor Harkness's *imperforate* specimen. The diagram under fig. 16 represents a lateral view of one of the dental plates (*a*), also a vertical section of the transverse septum (*b*) and its canal (*c*), drawn to a scale. The valve to which these structures belong is $2\frac{1}{4}$ inches in height. The dental plates stretch right across the umbonal cavity, from its vertex to a level about midway between the apex and the hinge; at this level the plates are about an inch in width. Adjoining the area their length is the same as the height of the valve; but, owing to their free margin having a deep concave curve, they suddenly decrease to an inch and one-eighth at a point about two-thirds across the umbonal cavity†; they gradually lengthen again in approaching the inner surface of the valve, getting about a quarter of an inch longer.

* See Davidson's paper in 'Geological Magazine,' July 1867, pl. 14. fig. 4 *t*.

† I find the dental plates to vary somewhat in length at the vertex of the curve in different specimens.

In the first stage in the process of rubbing down the umbone, the section (Pl. III. fig. 17), at the depth of one-eighth of an inch, displayed the dental plates (*a*) and the septum (*b*); the latter was nearly on a line with the area. In the second (fig. 18), at the depth of a quarter of an inch, the septum was more clearly distinguished as an independent structure; and its centre showed a trace of the canal (*c*). In the third (fig. 19), half an inch in depth, the septum was placed much further in, and the canal, now more obvious, was situated in the centre of its back. In the fourth (fig. 20), five-eighths of an inch, the canal, hitherto filled with a shelly deposit, was well displayed, and exhibited evidences of a foreign-mineral infilling. In the fifth (fig. 21), three-quarters of an inch, the septum was somewhat reduced in thickness, but the canal was larger and well filled with adventitious matter. In the sixth (fig. 22) seven-eighths of an inch, the septum had disappeared; the canal, however, was still present. In the seventh (fig. 23), one inch, the tube was getting faint; still the dental plates were seen crossing the entire width of the umbonal cavity. In the eighth and final stage, one inch and an eighth, both the canal and the central portion of the dental plates were gone.

It is thus evident that the septum and canal were an early development—that the latter became gradually filled up with a shelly substance in its oldest part, but remained open for about three-eighths of an inch at its distal extremity—that the canal projected beyond the free margin of the septum for about a quarter of an inch, and terminated on a level with the centre of the free margin of the dental plates.

These points are exactly in accordance with the appearances presented by a beautiful fossil cast, from the State of Ohio, for the loan of which I feel much indebted to Mr. Davidson: indeed the resemblance is such as to strongly impress me with the idea that the cast belongs to a shell specifically identical with Martin's *Spirifer cuspidatus*.

The canal of *Spirifer distans*, according to Davidson's figure, also remains open at its extremity; and such is the case in the Galway specimen of this species (fig. 10); it appears, however, to be more incomplete, and to rise more from the back of the septum, than the one belonging to *Spirifer cuspidatus*.

Some additional investigations which I have recently made among a number of other Spirifers may now be brought under notice. As *Spirifer striatus* is the type of the genus*, I am induced to give some details of its corresponding apophysis.

* This has been shown to be the case by Mr. Davidson, in the Introduction to his 'British Fossil Brachiopoda,' p. 81.

At first I could only be certain about the existence of the septum in its simple form. It was divided in the middle, or, in other terms, composed of two portions, each projecting from the inside of one of the dental plates, and separated from each other by a considerable interspace (fig. 24). Finding it in a similar condition in another specimen, I began to suspect that the component parts always remained disunited, as prevails in *Spirifer mosquensis*. In one specimen the division presented some appearance of being an incomplete canal; but, not being certain, I rubbed down the umbone of another specimen, two inches in width, and thus exposed the septum, well developed and enclosing the canal, as in fig. 25. I could have no doubt whatever that in this case the septum was canaliculated; but, in order to place the matter beyond dispute, I gave the specimen a further rubbing, which, though resulting in the obliteration of the circular form of the canal, confirmed the view I had taken, by disclosing it as a narrow slit dividing the septum (fig. 26). I have obtained corresponding results by similarly operating on some other species*. *Spirifer Verneuili*, from Boulogne, has the septum; but the canal is feebly indicated, just as it appeared in the second rubbing of Professor Harkness's specimen of *Sp. cuspidatus*. In *Sp. grandicostatus*, M'Coy, both are tolerably well displayed, the canal being situated on the back of the septum; the next rubbing entirely removed the canaliferous septum, leaving nothing but the dental plates extending right across the umbonal cavity (fig. 28). This was also the case in *Sp. striatus* and some other species: sometimes the outer half of the dental plates disappeared along with the septum. *Sp. crassus*, De Koninck, showed the apophysis somewhat obscurely at first; but on further rubbing, it became quite distinct (fig. 29).

In all the species last mentioned the space between the dental plates above the septum is simply filled with crystalline or amorphous mineral matter. In some others the same space contains a shelly deposit, which is particularly the case in the Permian *Sp. alatus*†. At first the latter circumstance seems to favour the idea that the arch is simply an excavation in the shell-substance of the pertaining valve. But this cannot be the case; for, as will be seen in fig. 9, the dental plates (*b*, *b*),

* The canaliferous septum is confined to the incurved or apical portion of the umbone, on which account it is with difficulty detected, and only by a close and frequent examination of the different surfaces obtained by rubbing. The canal is not often distinctly seen.

† The arch in this species does not always contain a shelly deposit, as casts before me, from Humbleton Hill, show that the inside of it has been quite divested of any extraneous infilling.

extending from the hinge to the opposite surface of the umbonal cavity, are present, though concealed as it were by a shelly deposit occupying the interspace between them. My rubbing of this species also shows what I take to be indications of the canal, this part being apparently represented by a dark spot (*d*) in the centre of the arch. The same appearance has occurred to me in the two specimens I have examined.

The various examples, representing a number of species, which have now been brought forward have an important bearing on the question raised by Dr. Carpenter's conclusion, inasmuch as the prevalency of the canaliferous septum plainly shows that this part is an essential structural element; this circumstance, moreover, strongly invalidates the idea that such a part characterized one species of shells, and was totally absent in another, the two being "not distinguishable from each other by external conformation." Apparently it has not occurred to Dr. Carpenter that the absence of the canaliferous septum, in Mr. Davidson's specimen, may be due to some accidental cause.

Mr. Davidson having kindly permitted me to operate on the specimen, I carefully ground down the upper half of the umbonal portion, sliced off by Dr. Carpenter, until scarcely anything remained. No canaliferous septum was exhibited, but there occurred to me some isolated platy fragments, which I suspect belonged to it. Besides, in the lower half, which remains in my possession, the dental plates, considerably reduced in width, do not retain their *original direction*, being much more inclined towards each other and to the plane of the area than is usual (fig. 30*)—a circumstance strongly in favour of their having been disturbed by pressure. Considering all points, I cannot but believe that Mr. Davidson's specimen, which disclosed to Dr. Carpenter "no vestige whatever" of the canaliferous septum, has lost this appendage†: it appears to me to have got detached from the dental plates, either before the inside of the shell became completely filled with mud, or before the mud got hardened.

With respect to the internal structure of the *small valve*, I have nothing to add to the account already given of it by

* This must be accepted as a perfectly exact representation of the dental plates, as the figure is a facsimile of an impression obtained from them and the outline of the valve.

† In consequence of the somewhat variable length of the canaliferous septum relatively to the dental plates in their middle, some specimens might show nothing, or no more than a faint trace, of the canal, on making a *single* slice across the umbone. An example of the first result, obtained in a specimen of *Spirifer grandicostatus*, is given in fig. 27, and of the latter, in *Sp. cuspidatus*, in fig. 23.

M'Coy and Davidson. The former has pointed out the existence of a "mesial septum, about one-third of the length in old specimens, rather more in small ones," in the valve now under consideration *; and the latter has represented an indication of the same part in one of his figures of the species†.

Myology.

Mr. Davidson's fossil cast of the interior of the larger valve, from the State of Ohio, which has all the appearance of belonging to *Spirifer cuspidatus*, displays the muscular impressions with singular beauty‡.

The principal muscles have been attached to the inner or convex surface of the medio-longitudinal hollow, and confined to the space between the dental plates (fig. 31). Their impressions form a group having a pear-shaped outline, the pointed end answering to the apex of the umbone, and the rounded end terminating a little more than one-fourth from the free margin of the hollow. They are longitudinally separated in their anterior three-fourths by a faint linear depression, *d* (or raised line on the inner surface of the valve), and their posterior fourth by a rather prominent irregularly indented ridge, *c*, which rises from the bottom of the anterior half of a deepish longitudinally oval cavity, *e* (elevation, *ibid.*). The most obvious impressions are two, *a*, *a*, one on each side of the faint linear depression, marked on their posterior half with about six longitudinal thickish ribs, intersected transversely or obliquely, also more or less complicated and obscured, by a number of raised diverging lines. The ribs on the transverse median line of the large impressions become once or twice divided, giving rise to about sixteen others, which are sharply defined: these run straight out, or with a slight curve, over the anterior half of the impressions§. Between the large im-

* British Palæozoic Fossils, p. 426.

† British Carboniferous Brachiopoda, pl. 8. fig. 21 *s*.

‡ It is worthy of being specially noted that the specimen has been presented to Mr. Davidson, with his usual liberality, by Prof. L. de Koninck. I must also take this opportunity of acknowledging the great kindness I have received from Mr. Davidson in my present researches; he has not only drawn the figures 30 and 31, but has materially aided me in other respects.

§ At first sight it might be supposed that the two large impressions actually represent two pairs, the posterior half being one pair, and the anterior half another. Seeing how different the posterior and anterior divisions appear, I was of this opinion myself for some time; but, observing that the fine ribs on the latter originated by subdivision from the strong ribs on the former, which is quite obvious on the right half (the left half in the figure), I felt the distinction was untenable.

pressions there is situated a smaller pair, neither well marked nor distinctly defined, *b*, *b*; and the rather prominent ridge, *c*, immediately behind the latter, I suspect represents another pair.

Besides the preceding, other muscular impressions are indicated by the longitudinal lines on and near the cast of the canal (fig. 32 *a*) belonging to the transverse septum*. These markings are important as clearly showing that the canal served as a muscular support, though such an office must have been limited to its open or terminal portion. The canal, from what has been adduced in the previous section, bears evidence of its older portion having become gradually closed up by the deposition of shelly matter in its interior.

It is not altogether safe to identify the different muscles which belonged to *Spirifer cuspidatus* with those known to characterize certain recent Palliobranchs, as made known by various writers, including myself†. I may, however, be allowed to offer a few suggestions in this direction.

The impressions lettered *a*, I have little doubt, represent the *ventral pedicle-muscles*; those marked *b* may, I am led to suspect, have been produced by the *valvulars* ("adductors"); and those distinguished by the letter *c* are probably the representatives of the *cardinals*.

There is some difficulty with the muscles belonging to the canal; and this is increased by the uncertainty that attaches to

* A representation of the canaliferous septum, as indicated by the cast of it, is given in fig. 33.

† The description which I have published, illustrating the muscular system of *Waldheimia australis*, first appeared in the 'Ann. & Mag. Nat. Hist.' vol. xviii., July 1846, and was copied, with the addition of some figures, in my 'Monograph of Permian Fossils,' pp. 73–76 (1850). It was the first one in English giving an account of a pair of muscles which pass from the inner surface of the perforated valve to the process (cardinal) in the centre of the hinge of the opposite valve. But it came to light some years afterwards (see Gratiolet, Académie des Sciences, Paris, July 11, 1853; and Davidson, Annals & Mag. Nat. Hist. ser. 2. vol. xvi. December 1855) that I had been anticipated by Prof. Quenstedt, who, in 1835 (Wiegmann's Archiv, vol. xi. pp. 220–222), pointed out the occurrence of the same muscles in *Rhynchonella psittacea*. Mr. Davidson, who has taken much pains in elucidating the history of the discovery of this point, and making known the general myology of the Palliobranchs (see Introduction to 'Monograph of British Fossil Brachiopoda,' pp. 53–56; and 'Annals,' above cited), has faithfully credited the various writers who have treated of the subject with the merits to which they are individually entitled. With the exception of some discoveries explaining the mode of attachment of the pedicle (or, rather, its capsule) to the surface of the umbonal cavity, and proving the existence of certain accessory muscles in the same part, nothing of importance in palliobranchial myology has been made known since the original publication of my description.

the use of the septum. The last of these points is of some importance; I may therefore be permitted to make a few remarks on it in the present place.

Although the canaliferous septum, including that portion of the dental plates which serves, as it were, for abutments, has been compared with the arch-shaped chamber characteristic of *Camarophoria*, *Pentamerus*, and *Stricklandinia*, I have some grounds for disbelieving it to be the homologue of the latter process. In *Camarophoria* and *Stricklandinia*, guided by the markings exhibited on some good casts of their chamber, and the absence of anything similar on casts of the pertaining valve, the muscles (their place in the genera mentioned is occupied by ovarian scars) to which reference has been made have undoubtedly been attached to the inner surface of the process*; but as these muscles in *Spirifer cuspidatus* have been fixed to the inner surface of the valve, the canaliferous septum must have supported some others. Can it have afforded attachment to the capsular muscle? In this case it might be concluded that the canal itself has served as a muscular fulcrum for the *dorsal pedicle-muscles*, which ordinarily have one extremity implanted on the intercrural plate of the dorsal valve, and the other attached to the pedicle†.

Generic considerations.

Although it has been shown that a number of Spirifers, including the type, *Sp. striatus*, are furnished with a canaliferous septum, I do not on this account consider that *Sp. cuspidatus* is a congeneric species; for the apophysis in the former cannot be said to exist beyond a comparatively rudimentary condition. Still I would not regard the more developed state of the canaliferous septum to be sufficient to constitute a generic distinction, were this appendage not associated with another important character. A perforated shell-tissue has been found in a number of species agreeing with *Sp. cuspidatus* in its apophysary system: I am therefore led to consider that the association individualizes a genus; and hence I am also led to adopt the name *Syringothyris*, which Prof. Winchell has appropriately applied to it.

* It is the same with the saucer-shaped process of *Leptæna analoga*, as I showed in 1850. (See precited Monograph, p. 75, pl. 20. fig. 6.)

† In *Cyrtia exporrecta*, which has no canaliferous septum, another arrangement seems to have obtained. Judging from markings which I perceive in the proper place on some good casts before me of this shell from Connemara, apparently the dorsal pedicle-muscles were attached to the dental plates adjoining the foramen.

Conclusion.

Sufficient has now been adduced to settle most satisfactorily the question at issue between Dr. Carpenter and myself as to the characters of *Syringothyris cuspidata*, as it may now be called.

The idea that the canaliferous septum and perforations are diagnostic features of the typical species of a certain genus, and that their absence distinguishes the type of another, both species being "undistinguishable by external conformation," must be unreservedly abandoned. The various evidences and considerations herein brought forward are totally opposed to any *isomorphism* of the kind; nay, the simple fact of a specimen, like Professor Harkness's, containing a well-developed canaliferous septum, but no perforations, is alone demonstrative of its complete fallacy. It may therefore be safely assumed that *Syringothyris cuspidata* and *S. typa* are one and the same species*.

II.—*Notes on* Helicograpsus, *a new Genus of Graptolites.*

By Henry Alleyne Nicholson, D.Sc., M.B., F.G.S.

The Graptolite for which I propose the above generic title was originally described by Hall, from the Hudson-River group, under the name of *Graptolithus gracilis* (Pal. N. York, vol. i. p. 274, and vol. iii. pp. 510–513). The first specimens which were discovered in Great Britain were obtained by Prof. Harkness from the Upper Llandeilo rocks of Dumfriesshire and Wigtonshire, and were described by him under the name of *Rastrites Barrandi* (Quart. Journ. Geol. Soc. vol. xi. p. 475). More recently it has been placed by Mr. W. Carruthers in his genus *Cladograpsus*, under the name of *C. gracilis* (Geol. Mag. vol. v. p. 130). Having, however, had the opportunity of examining an extensive suite of specimens, obtained by Prof. Harkness and myself from Glenkiln Burn, in Dumfriesshire, I still adhere to the opinion which I expressed some time ago, that it is unquestionably unique in its characters, and "should form the type of a new genus" (Geol. Mag. vol. iv. p. 258).

Gen. Char. Frond bilaterally symmetrical, composed of a non-celluliferous stem or "funicle," which is curved into the shape of the letter S, and gives off simple monoprionidian branches from the two convex portions of the curve, so that

* It will necessarily follow that Martin's specific name, having priority, must be adopted in preference to the one proposed by Prof. Winchell.

they form two distinct sets, which diverge in opposite directions. The extremities of the funicle, where the branches cease to be given off, become themselves also celluliferous on one side; and in the centre of the funicle a small radicle may occasionally be detected. The celluliferous branches do not subdivide or give origin to secondary branches, as far as has been observed. It is probable that the perfect polypary was composed of two fronds, such as above described, placed transversely across each other in a cruciform manner; and though none of our English examples would support this view, such a specimen has, according to Hall, been discovered in America (Grapt. of the Quebec Group, p. 14, note).

The above characters combine to form a Graptolite so essentially distinct from all others, that there can be no hesitation in forming a new genus for its reception. By Hall it was placed in his genus *Graptolithus*, in accordance with the belief which led him to place *Dichograpsus*, *Tetragrapsus*, and *Didymograpsus* in the same genus—the belief, namely, that there existed in nature no such simple forms of Graptolites as *G. sagittarius*, Linn., *G. Sedgwickii*, Portl., &c. The reference to *Rastrites* was founded upon imperfect fragments, and has long ago been given up by its author. There remains, then, only the reference to *Cladograpsus* by Mr. Carruthers; and a short consideration will show that this is certainly inapplicable. In the genus *Cladograpsus* (originally founded by Geinitz to include certain *Didymograpsi*) Mr. Carruthers placed, some years ago, a peculiar branching Graptolite, which he described under the name of *C. linearis* (Ann. & Mag. Nat. Hist. ser. 3. vol. iii. No. 13). This he subsequently abandoned, placing the form in question under the genus *Dendrograpsus*, Hall (Geol. Mag. vol. iv. No. 2. p. 70). It was then described by myself as the type of a new genus, under the name of *Pleurograpsus linearis* (*ibid.* vol. iv. p. 256); and I at that time pointed out that the essential point in the definition of the genus, whereby it was distinguished from all other branching Graptolites known to me, was the entire absence of a "funicle," or non-celluliferous basis, the frond consisting of a main celluliferous rachis giving off celluliferous branches, which in turn gave origin to secondary branches. Finally Mr. Carruthers returned again to the genus *Cladograpsus*, redefining it as follows:—"Polypary compound, growing bilaterally from the primary point, *irregularly and repeatedly branching and rebranching*, and without a central disk;" and he placed under this head both *Pleurograpsus linearis* and *Graptolithus gracilis* (*ibid.* vol. v. p. 129). Now a comparison of the respec-

tive characters of these two Graptolites demonstrates at once, as shown by the annexed diagrammatic sketches, the following fundamental differences:—*Pleurograpsus* is distinguished by the total absence of anything like a "funicle," by the "irregular" manner in which the branches are given off from opposite sides of the main celluliferous stipes, and by the presence of secondary branches. *Helicograpsus*, on the other hand, is characterized by the possession of a long and remarkably distinct funicle, by the regular and definite plan upon which the branches are given off, and by the absence of secondary offsets.

Fig. 1.

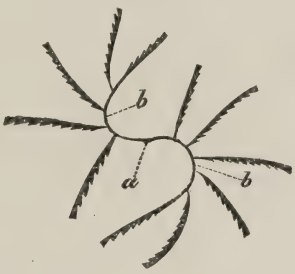


Fig. 2.

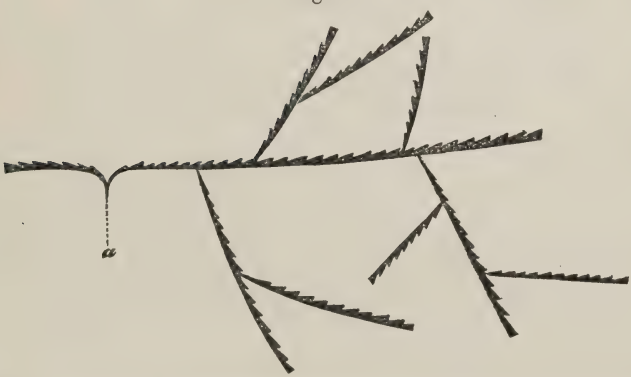


Fig. 1. Sketch of *Helicograpsus gracilis*, Hall, sp.: *a*, radicle; *b*, funicle.
Fig. 2. Sketch of *Pleurograpsus linearis*, Carr., sp.

As the above-mentioned distinctions are as broad and as weighty as those which separate *any* of the genera of the Graptolitidæ from each other, there can be no hesitation in following the usual rule in the case of *Pleurograpsus* and *Helicograpsus*.

Hitherto one Graptolite only has been discovered which can

be referred to the genus *Helicograpsus*, viz. *H. gracilis*, Hall, sp.; and it is distinguished by the following characters:—

Frond compound, consisting of a tubular S-shaped funicle, which gives off two sets of monoprionidian branches, one from each of the convex portions of the curve, in the manner described under the genus. The "funicle" itself is very slender, and in some specimens shows traces of a small triangular radicle in its centre. The celluliferous branches are from eight to twelve in number (*i. e.* four to six in each set) in most of our specimens; but they are as many as thirty-three in an example figured by Hall. The first branches are almost rectangular to the funicle, but the later ones become gradually less so. They are very narrow at their commencement, but widen out till a breadth of $\frac{1}{40}$ to $\frac{1}{30}$ inch may be attained; and this would doubtless be exceeded in larger specimens. The cellules are from twenty-five to thirty in the space of an inch, inclined to the axis at a small angle, the cell-mouths rectangular to the axis, and running partially across the stipe.

Loc. Common, and tolerably well preserved, in the anthracitic shales of Glenkiln Burn, in Dumfriesshire. Rare in the black slates of Cairn Ryan, Wigtonshire.

III.—*A few words on* Euplectella aspergillum, *Owen, and its Inhabitants.* By C. Semper*.

The last numbers of the 'Annals of Natural History,' for December 1866 (p. 487) and January 1867 (p. 44), gave us two small memoirs by John Edward Gray upon a Sponge from the Philippines which was known to the travellers Quoy and Gaimard, and more accurately described by Owen, in 1841, under the generic name of *Euplectella*. Apparently this Sponge has hitherto been one of the greatest rarities in our museums; and it is only within the last few years that a greater number of specimens, derived from the Philippines, have come to Europe. As I believe that I have no unimportant share in this increase of museum treasures, and have had the opportunity of seeing a considerable number of them, both here and in the Philippines, I will venture to make a few remarks upon them. So long as I had only a few claims of priority to make, I thought I might keep silence; but now, when it appears as

* Translated by W. S. Dallas, F.L.S. &c., from Wiegmann's 'Archiv,' 1867, pp. 84–89.

if the simplest circumstances threatened to become confused by the help of our *savants*, who do not hesitate to support by scientific reasonings the simple fancies of a set of fishermen, I think it is time for me to bring my own observations to light.

Under the name of "regadera"*, these sponges are brought by the fishermen for sale to Cebú, one of the Visaya islands. In the course of several years I myself saw there seven or eight specimens; and, as I was told by a very intelligent mestizo in the town, about twelve to fourteen specimens in all had, up to that time (1864) been sent to Europe. As, however, nearly all these specimens, having been bought by Spaniards, went to Spain, and probably remained for the most part as ornaments in the state rooms of private individuals, we may easily understand how, since the investigations of Owen and Bowerbank, no further details as to these organisms came into the possession of the scientific world. Recently the fishermen of Cebú seem to have discovered the true habitat of the sponge; at least this is indicated by the rapidly increasing number of the specimens of *Euplectella* since my return in the year 1865. This was certainly not the case during my residence. In a dredging voyage which I made in the year 1864 round the neighbouring island of Bohol; and in the channel between Bohol and Cebú I anchored for two days in 120 fathoms, at the spot where the fishermen of S. Nicolas asserted they had found the *Euplectella*. As I fished for them in vain, it seems probable that they had deceived me as well as all other Europeans, so as not to bring down the price of the sponges by betraying the place of their origin—a stratagem which is well known to be employed not only by Malay fishermen. As I was unlucky in my fishing, I purchased a specimen, which, unfortunately, was much bleached and no longer fresh. Subsequently I obtained through a kind friend fourteen specimens, all, with the exception of two, perfectly preserved. Nearly all of these contained the crustacean which I had long known, and the association of which with this sponge was first made known by Gray.

* "Regadera" means "watering-pot." The false spelling ("rigederos") of Messrs. H. Chevalier and Gray reminds me vividly of a time when I endeavoured in vain to teach an English sailor the correct pronunciation of some Spanish names. The Spanish *e* and *a* were constantly pronounced by him as *i* and *e*. Exactly the same orthography seems to have been adopted in the above case. I might venture here to cite a third, and this time a Germanized spelling of the Spanish word "regadera," namely "reidschidiros." By such felicitous changes we may hope by degrees to introduce this denomination again into the Philippines as true Malay. At least, the attempted derivations of the word "Papua" show the possibility of this in an allied case.

As Gray correctly observes, the Spaniards in Cebú and Manilla regard this sponge as a house built for itself by the inhabitant. To judge from Gray's last memoir, this opinion seems now to have been adopted by a French naturalist unknown to me, M. Trimoulet, of Bordeaux. When Gray adds, "The [Spanish?] fishermen's theory has found one *scientific* supporter at least," I should be inclined to regard the word "scientific" as employed only *cum grano salis*. In fact the most superficial knowledge of the structure of the sponge on the one hand, and of the habits of the Crustacea on the other, suffices to prove that this opinion might certainly originate in the brain of a Malay fisherman, but that its *scientific* assertion would be a most startling task, which few would have desire or courage to undertake. It is true one must make discoveries; and if they are accepted and become the fashion only for a short time, this is perhaps sufficient for the attainment of the desired honour. I regard it as superfluous, after the beautiful investigations of Owen and Bowerbank upon this sponge, to describe its intimate structure over again, in order to strengthen the assertion that this French *savant* must and will find himself in error.

And even if Trimoulet's assertion "that it is the nest of a crustacean of the section of the *Isopodes nageurs*" were quite correct, it is true that an Isopod, a true *Æga*, lives in the sponge, but not alone; for even still more frequently we find in it a pair of a pretty Palæmonid, which, unfortunately, I cannot determine generically from the much damaged specimens now before me. If M. Trimoulet's "renseignements" had been a little more complete, he would also have heard from the same Spaniards in Cebú that the "Cuca"* (that is to say, my *Æga spongiophila*) is always found singly, but that, on the contrary, the "Camarones"† (the Palæmonidæ above mentioned) always live in it in pairs—a married couple and the friend of the family! And, according to Trimoulet, it is probable that their united endeavours have succeeded in weaving together the delicate siliceous web of the whole sponge, both without and within. Both forms of crustacea have long been known to me. Of one of them (*Æga spongiophila*) I made a sufficiently careful drawing in Cebú,

* "Cuca" is abbreviated from the Spanish word "cucaracha," by which, in Spain, all kinds of cockroaches and also the Asellini are indicated.

† "Camaron" is the Spanish name for every Palæmonid, both of fresh and salt water. Both denominations furnish a fresh proof of how correctly uneducated and so-called savage people are frequently guided by their sharpened senses.

endeavouring to bring the animal in all positions before some of the larger openings in the terminal disk, as I could not destroy the sponge itself. The two *Palæmonidæ*, on the contrary, were always too much injured, in all the specimens which then came under my inspection, to allow them to be drawn under such difficulties. As I am not at the moment able to prepare drawings of the crustacea, of which I have several specimens now before me, I must content myself for the present with a short description, which I hope to follow speedily with a more accurate one, accompanied by figures.

Ægа spongiophila, n. sp.

The head is rounded off in front, and strongly bent downwards. The two eyes are very large, but do not touch each other, leaving the forehead produced into a small point between them; the broad basal joints of the antennæ originate at the sides of the forehead. The first joint of the upper antennæ is nearly quadrangular, twice as broad as the length of the frontal point; the second joint somewhat smaller; the third joint is thin and cylindrical, and reaches to the middle of the eyes; the terminal filament is many-jointed, and does not reach quite to the hind margin of the first thoracic segment. The inferior antennæ commence with two short but broad joints; the three following long and cylindrical joints reach nearly to the end of the inner antennæ; and the small-jointed terminal flagellum goes to the commencement of the abdomen. The epimera of the first seven segments of the body are large and lanceolate. The first segment of the postabdomen is the narrowest, and the penultimate the broadest. The last abdominal segment is straight-margined anteriorly, strongly curved behind. The lamellæ of the abdominal swimming-feet are acutely oval, and do not protrude beyond the hinder margin of the last segment.

The description of the Palæmonid I will reserve for the present, as I hope soon to be able to make a better one, from perfect specimens preserved in spirits, than would be possible now from the dried and partially destroyed animals.

In conclusion, I will only make a few remarks upon the Sponge itself. Bowerbank's censure of Owen has been duly refuted in the above-mentioned article by J. E. Gray; but when Gray unconditionally defines the Sponge described by Quoy & Gaimard as identical with that from the Philippines, I must declare myself opposed to this view, until accurate in-

vestigations of the two forms have proved their identity*. Quoy and Gaimard's species, as is well known, is from the Moluccas, and not from the Philippines. Gray ought therefore, at any rate, to have given this habitat also. However, I do not make this observation in order to preserve a "species," but because I should be sorry to lose Owen's beautiful name *Euplectella aspergillum*, which, in its specific denomination, gives a simple translation of the name "regadera," invented by the people, and therefore certainly better characterizes this animal than the common Latin expression "speciosa," or Gray's English popular name "Venus's Flower-basket."

Würzburg, January 19, 1867.

IV.—*Contributions to the Study of the Entomostraca.*

By George Stewardson Brady, C.M.Z.S. &c.

[Plates IV. & V.]

Under this title I propose to give, from time to time, descriptions of new species and remarks on any other points of interest connected with the Entomostraca which may chance to come under my notice.

No. I. *Ostracoda from the Arctic and Scandinavian Seas.*

The specimens dealt with in the present paper have been derived from mud and sand procured by the captains of whalers from the Arctic seas, and from dredgings made on the coast of Norway by David Robertson, Esq., of Glasgow, to whom, in conjunction with the Rev. H. W. Crosskey, I am indebted for the opportunity of describing the following species.

In the 'Transactions of the Zoological Society' I have already (vol. v. 1865) described several Arctic species which were obtained from Dr. Sutherland's dredgings. But the nomenclature of that memoir requires rectification. I now give an amended list of the species there noticed:—

Hunde Islands, Baffin's Bay, 60–70 fathoms.

Cythere tuberculata (*G. O. Sars*).
—— emarginata (*G. O. Sars*).
—— costata, *Brady*.
—— septentrionalis, *Brady*.
Cythere limicola (*Norman*) (= C. areolata, *Brady, loc. cit.*).
—— angulata? (*G. O. Sars*) (= C. clathrata, *var.* nuda, *Brady, loc. cit.*).
Cytheridea papillosa, *Bosquet*.

* Dr. Gray, in the 'Proceedings of the Zoological Society' for 1867, has not only acknowledged the distinctness of the species, but has formed of it a second section of the family Euplectelladæ. According to him, *Alcyoncellum speciosum* (Q. & G.) constitutes a genus distinct from *E. corbicula*.

Hab. Lat. 67° 17′ N., long. 62° 21′ W. Six feet below low-water mark.

This species is very closely related to *C. emarginata*, Sars, but is altogether destitute of the peculiar angulated ridge which runs across the hinder portion of the valves in that species; the surface-markings are also less sharply cut and less angular. The valves are precisely similar to those of *C. emarginata* in later[illegible]line; and, as in the following species, it is most difficult [illegible] positively whether the differences which have been poi[illegible]out are dependent upon habitat only, or upon more deeply-seated innate causes. These often recurring cases tend strongly to impress one with the idea, though they certainly do not prove the fact, of a community of descent. Many of the less-strongly sculptured examples of this species appear very distinct; but others approach *C. emarginata* very closely, and some occupy apparently an intermediate position between that species and *C. finmarchica*, to which latter species the dorsal aspect of *C. borealis* bears great resemblance.

Cythere pulchella, Brady. (Plate V. figs. 18–20.)

Cythere pulchella, Brady, Monog. Recent Brit. Ostrac. p. 404.

Carapace of the female, as seen from the side, subreniform; greatest height situated in the middle, and equal to more than half the length: anterior extremity broadly rounded; posterior narrowed, obliquely subtruncate: superior mar[illegible] boldly arched, highest near the middle; inferior sinuat[illegible] the middle: seen from above ovate, widest a little behi[illegible] middle; width scarcely equal to half the length, extrem[illegible] obtusely pointed. Shell-surface covered with closely rounded, shallow puncta; colour reddish-brown. [illegible] hinge-teeth of the right valve form two projecting ridg[illegible] which end abruptly at their terminal extremities, but sl[illegible] gradually towards the middle of the hinge-line, and [illegible] crenulated on their edges. The flagellum or urticating [illegible] of the second antenna in the female is biarticulate, long [illegible] slender; the upper antenna armed at the apices of the [illegible] last joints with slender, slightly curved spines, third [illegible] fourth joints coalescent. The mandibular palp bears thre[illegible] curved plumose setæ. Feet short and stout, their termina[illegible] claws much dilated at the base, nearly straight in the middle, and suddenly curved (almost hooked) at the apex. Length $\frac{1}{38}$ inch.

It is with some hesitation that I accord to this a specific rank as distinct from *C. rubida*, feeling by no means certain that the last-named species may not be a dwarfed southern

Cytheridea pulchra, *Brady*.
—— oryza, *Brady*.
Bythocythere simplex (*Norman*) (= Jonesia simplex, *Brady*, *loc. cit.*).
Cytheropteron latissimum (*Norman*) (= Cythere latissima, *Brady*, *loc. cit.*).
Cytherura clathrata, *G. O. Sars*.
Paradoxostoma variabile (*Baird*).

Cumberland Inlet, 15½ fathoms.
Lat. 66° 10′ N., long. 67° 15′ W.
Cythere dunelmensis (*Norman*).
Cytheropteron montrosiense, *C. B. & R.*
—— vespertilio (*Reuss*).
—— inflatum, *C. B. & R.*
Cytherura undata, *G. O. Sars*.

Davis's Straits.
Lat. 67° 17′ N., long. 62° 21′ W.
6 feet below low-water mark.
Cythere lutea, *Müller*.
—— villosa (*G. O. Sars*).
—— finmarchica (*G. O. Sars*).
—— borealis, *nov. sp.*
—— emarginata (*G. O. Sars*).
—— angula[illegible] *O. Sars*).
—— pulch[illegible]*rady*.
—— tuber[illegible] *G. O. Sars*).
—— concin[illegible]*ies*.
Cytheridea p[illegible]illosa, *Bosquet*.
Cytherura rudis, *nov. sp.*
Paradoxostoma variabile (*Baird*).

Iceland (in shell-sand).
Cythere lutea, *Müller*.
—— borealis, *nov. sp.*
—— emarginata (*G. O. Sars*).

Cythere borealis, nov. sp. (Plate IV. figs. 1–4, 6, 7.)

Carapace of female, seen laterally, subreniform, highest in the middle; greatest height equal to more than half the length: anterior extremity obliquely rounded; posterior subtruncate, somewhat emarginate above the middle: superior margin arched, inferior sinuated in front of the middle. Outline, as seen from above, ovate, widest in the middle, extremities obtusely mucronate; width equal to half the length. The right valve differs from the left in shape, being higher, with the dorsal margin more boldly arched, distinctly excavated in front of the eyes, and much more conspicuously emarginate behind. The hinge-joint is formed, in the left valve, by a crenulated median bar, with a moderately strong anterior tooth-like process; in the right valve by a small anterior tooth and a slightly crenulated posterior projection. The shell of the male is longer and narrower, with the anterior margin produced downwards and numerously serrated. Surface of the valves covered with shallow, rounded (and often distant) pits, but not at all ridged or tuberculated. Colour yellowish brown. Upper antennæ robust, six-jointed, fourth and fifth joints coalescent, last four joints armed with strong, flexuous, apical spines; flagellum of lower antennæ in the female short and robust. Feet long and strong; second joint of last foot shorter than the two succeeding joints, terminal claws long and pectinated on the concave border. Male copulative organs of moderate size, posterior segment obtusely triangular. Length $\frac{1}{29}$ inch.

form of the present, which seems to be a peculiarly Arctic species. The points of difference are chiefly these: *C. pulchella* has a more boldly arched dorsal margin, is considerably larger, and its greatest width is placed behind the middle; its hinge-teeth are also much better developed; the terminal claws of all the feet differ remarkably in their conformation from those of *C. rubida*, and the urticating setæ are also of different type: it is, indeed, chiefly this latter character which induces me to keep the two species separate. From *C. villosa* it may be distinguished by the colour of the shell, its much more delicate punctation and greater tumidity, as well as by its less-angular lateral outline. The single specimen which obtained *C. pulchella* a place in my monograph of the British Ostracoda was small and probably immature; and as the fine series of specimens obtained by Mr. Crosskey from Davis's Straits afforded an opportunity for a more complete examination, both of the external and internal characters of the species, I have thought it well in this place to redescribe it from the Arctic specimens. It may be noted that the fossil glacial specimens are somewhat intermediate in character between these and *C. rubida*.

Hab. Lat. 67° 17′ N., long. 62° 21′ W. Six feet below low-water mark.

Cythere Robertsoni, nov. sp. (Pl. IV. figs. 5, 8–10.)

Shell of the female compressed, subcuneiform, much higher in front than behind; greatest height situated at the anterior third, and equal to rather more than half the length: extremities obliquely rounded; anterior broad, posterior narrowed: superior margin straight, sloping steeply from before backwards; inferior sinuated in the middle, curving upwards behind. Seen from above, compressed, oblong, with nearly parallel sides; anterior extremity acuminate, posterior suddenly tapered, obtusely pointed; width much less than half the length. End view ovate, widest in the middle. Shell of the male much narrower; surface of the shell covered with closely set angular pittings; colour yellowish. Length $\frac{1}{52}$ inch.

This very distinct and pretty little species was dredged by Mr. D. Robertson, at Drobak, Christianiafiord, in a depth of 30–35 fathoms. I have much pleasure in dedicating it to its discoverer.

Cytheropteron vespertilio (Reuss). (Plate V. figs. 6, 7.)
—— *montrosiense*, C. B. & R. (Plate V. figs. 1–5.)
—— *inflatum*, C. B. & R. (Plate V. figs. 8–10.)

Our knowledge of these species is derived chiefly from fossil

specimens found in the Scottish glacial clays. The description of them is therefore left for a "Monograph of the British Posttertiary Entomostraca," which is now in preparation for the Palæontographical Society, by Messrs. Crosskey and Robertson, in conjunction with the present writer. I have, however, thought it desirable to give here figures drawn from the recent Arctic specimens, the joint occurrence of these (the only known recent specimens) being of very considerable interest in connexion with their distribution in the fossil state.

Cytheropteron pyramidale, nov. sp. (Plate V. figs. 11–14.)

Carapace tumid, subpyramidal; seen from the side, subrhomboidal, highest in the middle, greatest height equal to more than half the length; anterior extremity obliquely rounded, posterior narrowed and produced in the middle: superior margin very strongly arched, highest in the middle, and sloping steeply towards each extremity; inferior convex, bending upwards behind. Outline, as seen from above, subhexagonal, widest behind the middle, suddenly and sharply acuminate in front, strongly mucronate behind; width and height equal. End view triangular, sides very slightly convex. Shell-surface marked with conspicuous fossæ, which are arranged in transverse curved rows; ventral surface sculptured with interrupted longitudinal furrows. Length $\frac{1}{45}$ inch.

Dredged by Messrs. Robertson and Crosskey in 25–30 fathoms, amongst mud, at Drobak, Christianiafiord.

This species, though in general appearance approaching very closely *C. latissimum*, differs considerably in the proportions of the carapace, being much more tumid when seen from above; the sculpturing of the surface is also much deeper and more distinct, especially on the ventral aspect, and the sides are less convex; the contours are also altogether less rounded than in its neighbour species.

Cytherura rudis, nov. sp. (Plate V. figs. 15–17.)

Carapace, seen laterally, subrhomboidal, nearly equal in height throughout; height equal to more than half the length: anterior extremity obliquely rounded, posterior produced in the middle into an obscurely angular beak; superior margin very slightly arched, inferior almost straight: seen from above, the outline is ovate, widest in the middle, sharply pointed in front, mucronate behind; greatest width equal to half the length. End view subpentagonal, widest in the middle; the ventral surface concave, keeled in the middle. Surface of the valves covered with rather large angular

pits, and having a sharply angular ridge or crest just within and parallel to the ventral margin. Colour white. Length $\frac{1}{52}$ inch.

Two specimens only in the gathering from Davis's Straits. In shape these agree very closely with Sars's *C. atra*; but the sculpture and colour of the shell would seem to be different. The description " valvulæ distincte et sat regulariter reticulatæ, areola mediana obsoleta. Testa tota colore saturatissime atro insignis " does not apply here. The sculpturing of *C. rudis*, is too decided to be called mere reticulation; and there is no trace of coloration of any kind in our specimens.

EXPLANATION OF THE PLATES.

Plate IV.

Fig. 1. *Cythere borealis* (female), from left side. ×40.
Fig. 2. The same, from above.
Fig. 3. The same (male), from left side.
Fig. 4. The same (male), from below.
Fig. 6. The same, outline of left valve (female).
Fig. 7. The same, outline of right valve (female).
Fig. 5. *Cythere Robertsoni* (female), seen from left side. ×84.
Fig. 8. The same, seen from above.
Fig. 9. The same, seen from below.
Fig. 10. The same, seen from front.
Fig. 11. *Pontocypris attenuata*, seen from left side.
Fig. 12. The same, seen from above.
Fig. 13. The same, seen from below.
Fig. 14. The same, end view.

[The description of *Pontocypris attenuata* (a southern species) will be given in a subsequent paper.]

Plate V.

Fig. 1. *Cytheropteron montrosiense* (adult female), seen from left side. ×50.
Fig. 2. The same, seen from above.
Fig. 3. The same, end view.
Fig. 4. The same (young?), seen from left side.
Fig. 5. The same, seen from below.
Fig. 6. *Cytheropteron vespertilio*, right valve, seen from outside.
Fig. 7. The same, seen from above.
Fig. 8. *Cytheropteron inflatum*, right valve, seen from outside.
Fig. 9. The same, seen from above.
Fig. 10. The same, end view.
Fig. 11. *Cytheropteron pyramidale*, seen from left side.
Fig. 12. The same, seen from above.
Fig. 13. The same, seen from below.
Fig. 14. The same, seen from behind.
Fig. 15. *Cytherura rudis*, seen from left side.
Fig. 16. The same, seen from above.
Fig. 17. The same, seen from the front.
Fig. 18. *Cythere pulchella* (female), seen from left side. ×40.
Fig. 19. The same, seen from above.
Fig. 20. The same, seen from the front.

V.—*On* Hyalonema boreale. By J. V. Barboza du Bocage.

To Dr. J. E. Gray, F.R.S.

My dear Friend, Lisbon, May 6, 1868.

I have just received the interesting memoir of M. Lovén upon *Hyalonema boreale* *. I must confess that M. Lovén's publication has caused me some vexation, as more than two months ago I prepared a similar memoir, which I have been hitherto prevented from publishing by illness. Since the 17th of February I have been in possession of two curious specimens of a Spongiad, which I immediately regarded as the young of *Hyalonema lusitanicum*.

I find some important differences between my specimens and that described by Lovén. In the first place, the sponge which forms the head has no apparent *osculum*; and then the sarcode is covered with very complicated spiny spicules, which are not noticed by Lovén.

I do not share all Lovén's ideas. I cannot admit that the sponge which accompanies several specimens of *Hyalomena* from Portugal and Japan is the *sponge-head* of the young specimens; on the contrary, I am persuaded that the sponge which persists in the adult specimens is precisely that which forms the dilatation of the base, so that it is the upper portion or extremity of the filaments which remains free. The following are my reasons:—

1. I remarked in my two young specimens that the large spicules constituting the axis all terminate below at the same level, whilst their superior extremities remain at different elevations. Now all the adult specimens present this same character: the filaments have their extremities at the same level in the part enclosed in the sponge, whilst they show their free extremities at different heights. I think therefore that this sponge is inferior, and that it corresponds to the sponge which occurs at the base of the young specimens. (As a matter of course, I regard the specimen figured by Lovén as a *young Hyalonema*.)



Height 75 centims.; diameter of the sponge 17 centims.

2. The following is another argument in favour of my opinion. I possess a very

* [A translation of this memoir, with which we have been kindly furnished by the author, will appear in our next Number.—Ed.]

curious example of *Hyalonema lusitanicum*, in which there are two bundles of filaments to a single sponge, nearly as in the annexed drawing (p. 36). Now I can perfectly conceive that the two bases, originally distinct, have become confounded together with increasing age; but I cannot understand this confusion if we are to assume that the natural position of *Hyalonema* is the reverse of that indicated in my sketch.

I am now convinced that *Hyalonema* is a sponge. As to the polypes (*Palythoa fatua*, Schultze), I regard them as parasites. I have several specimens of *Hyalonema* with other parasites: two are covered with an Antipatharian, three absolutely destitute of polypes and sponges, one embraced by the foot of an *Actinia* of what seems to me a new species. It is a flesh-coloured *Actinia* of enormous size.

I am still suffering from my recent illness. As soon as I am a little recovered, I shall endeavour to publish some supplementary notes upon the discovery of our learned friend Lovén.

Believe me, always your devoted friend,

J. V. Barboza du Bocage.

My dear Friend, Lisbon, May 10, 1868.

After a more careful examination of our two little sponges, I have arrived at somewhat different results, which I hasten to

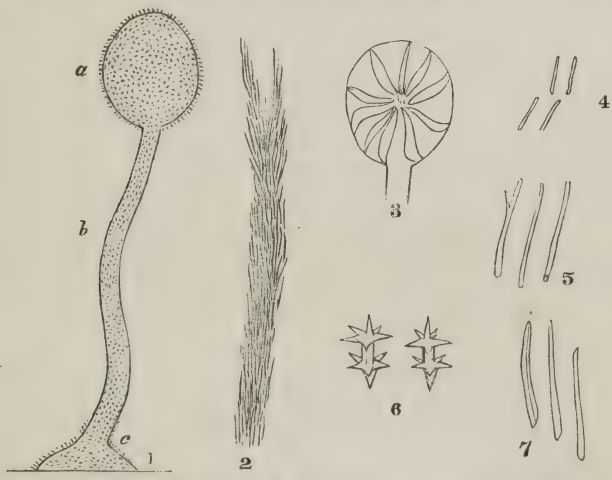


Fig. 1. *a*, head; *b*, stem; *c*, base. Fig. 2. Aggregation of linear spicules forming the stem. Fig. 3. Interior of the head to show the radiating bundles. Fig. 4. Spicules implanted perpendicularly upon the head and base. Fig. 5. Spicules of the radiating bundles. Fig. 6. Spinous spicules of the sarcode of the stem. Fig. 7. Spicules of the stem or axis.

communicate to you, because they completely change my first impression.

The axis or stem of the sponge is composed of an aggregation of linear spicules. I thought at first that each of these spicules extended uninterruptedly, like those of *Hyalonema*, from the base to the apex; but I have now ascertained that these spicules are, on the contrary, short in proportion to the dimensions of the axis, and that it is by their regular aggregation that this axis is formed. To make myself more intelligible, I will say that the axis does not at all resemble that of *Hyalonema*, but is constituted as in figure 2.

The axis of *Hyalonema boreale* seems to me to present an identical structure; but Lovén has not noticed all the importance of this difference as compared with the true *Hyalonemata*.

In my opinion, therefore, my two little sponges are not, as I at first thought, the young of *Hyalonema lusitanicum*; on the contrary, I am convinced that they must belong to a perfectly distinct genus, which I intend to name *Lovenia*.

To this same genus *Hyalonema boreale*, Lovén, must belong; it is perhaps identical with my two specimens. The only difference of any importance which prevents my proposing this identification is that Lovén does not seem to have detected the spiny spicules implanted in the sarcode in his two specimens, whilst the surface of mine is covered with them. Perhaps this apparent difference is only the result of an imperfect observation.

The new genus *Lovenia* will therefore be characterized by the existence of a solid axis or stem composed of an aggregation of short linear spicules, covered by a very distinct layer of sarcode, in which are implanted small defensive spicules analogous to those of the genus *Aphrocallistes*, according to the drawing published by Wyville Thomson (Ann. & Mag. Nat. Hist., February 1868). This stem is surmounted by a rounded head composed of radiating filaments, formed by linear spicules analogous to those of the stem. Other linear spicules, but shorter and in the form of little bacilli, are implanted perpendicularly to the surface of the head and in the spreading part of the base.

I am busy at present studying the structure of the sponges which accompany many of my specimens of *Hyalonema lusitanicum*, and I shall soon communicate to you the results of my observations.

The pertinacity with which Dr. Bowerbank regards the animals of the *Palythoa* as the *oscula* of a sponge, astonishes me more and more whenever I think of it!

You will soon hear from me again. Believe me, your devoted friend,

J. V. Barboza du Bocage.

VI.—*On the* Tricuspidarieæ, *a Subtribe of the* Elæocarpeæ.

By John Miers, F.R.S., F.L.S., &c.

The *Elæocarpeæ*, as a natural order distinct from *Tiliaceæ*, was proposed in 1808 by Jussieu, who united with it the *Tricuspidaria* and *Vallea* of the 'Flora Peruviana.' Kunth, in 1821, followed this example; but, in a note, he suggested that it might well form a distinct tribe of the *Tiliaceæ*. De Candolle, in 1821, adopted the view of Jussieu, adding to the list *Friesia* and others now subgenera of *Elæocarpus*. Lindley, in 1836, in his 'Nat. Syst.,' followed a similar course; but in 1845, in his 'Veget. Kingd.,' he adopted the hint suggested by Kunth, uniting the family with *Tiliaceæ* as a distinct tribe. The authors of the new 'Genera Plantarum,' in 1862, followed this arrangement under some modifications, excluding *Vallea* upon very insufficient data, and amalgamating *Friesia* with *Aristotelia* and *Crinodendron* with *Tricuspidaria* upon slender grounds. After a careful examination of these several genera, I am led to follow the views of Endlicher in maintaining the *Tricuspidariæ* as a subtribe distinct from *Elæocarpeæ*, which are distinguished from one another by very salient and constant characters. In the former the petals, though three-lobed at the apex or nearly entire, are never fringed as in the *Elæocarpeæ*; in the latter the fruit is a drupe, with a single thick osseous mesocarp, assuming the shape of an indehiscent tuberculated nut, which, by abortion, is seldom more than 1- or 2-celled, each cell producing a single seed (not suspended from the summit, as generally stated, but) appended by the middle of its ventral face. On the other hand, the *Tricuspidariæ*, besides the difference in the form of the petals, have a fruit always 3–5-celled, with two or more superposed seeds in each cell, and either capsular and dehiscent or else baccate with a membranous endocarp. But a still more forcible distinction exists in the nature of the integuments of the seeds. In the *Elæocarpeæ* the outer integument is chartaceous, thin, and brittle, the second tunic being submembranaceous; but there is no osseous coat. In the *Tricuspidarieæ* the seeds invariably have three tunics: the outer one is thick and fleshy, in which the chord of the raphe is imbedded; the second coat is thick, osseous, obpyriform, truncated at its base, where, beneath the chalaza, there is always a distinct chamber, into which the vessels of the raphe find their way; the third tunic is opaque, somewhat membranaceous, with a large orbicular chalaza at its base, corresponding with the chalazal base of the bony tunic. No structure of this kind is seen in the *Elæocarpeæ*; but it is constant in all the *Tricuspidarieæ*. An ana-

logous organization is observable in the *Sloaneæ*, the seeds of which have a similar red-coloured fleshy covering, which has been designated by some authors an arillus; the second tunic is osseous, and broadly truncated at its base by a large orbicular chalaza; but this wants the hollow chamber below it, which forms a characteristic feature in the *Tricuspidarieæ*.

In regard to the nature of these seminal envelopes, the outer coat may be regarded as an *arilline*, analogous to a similar tunic which I formerly described covering the osseous coat in the seeds of *Clusia* and *Magnolia**. Upon the nature and origin of these integuments I then endeavoured to offer an explanation, which was contested by others, who maintained that in these cases the outer fleshy covering is merely the epidermis of the bony coat, both being elicited by the growth of one single tunic, the primine of the ovule. There is a bar to such an argument, in the instance of *Aristotelia*, in the existence of the singular appendage upon the outer fleshy coat, resulting from the duplicature of that integument, which could not occur if it were merely an epidermis. By those who have not studied the subject, the origin of this appendage might be attributed to a fungous enlargement of the funicle (as Gaertner supposed in an analogous instance†) or to an expansion of the chalaza; but a more careful examination will show that it is too remote from the latter and from the hilum to admit of such a supposition. Whatever be its origin, this outer tunic appears to be an integument wholly independent of the bony shell, consisting of its reticulated epiderm, a fleshy mesoderm replete with resinous cells, and an endoderm in the form of a white, opaque, reticulated cuticle, separable from the shell, the chord of the raphe being found within its substance.

The fact that this fleshy tunic and bony shell are two distinct integuments is shown by an examination of the unimpregnated ovules in the abortive cells of *Aristotelia*: here, with the ovules grown to the length of half a line, I have succeeded, by means of a longitudinal section, in actually separating them. The tunics, which, if fertilized, would have grown into the fleshy coating and bony shell, are then seen as two distinct, thin, membranaceous integuments, easily separable at this stage, the second being a little shorter and more pointed than the first or outer one, the third integument, enclosing the rudimentary nucleus, being still shorter than the others. It is worthy of notice that at this stage the outer integument exhibits the peculiar appendage or duplicature so conspicuous in the ripe seed.

* Linn. Trans. xxii. 89, tab. 19. figs. 56–59; Contrib. Bot. i. 219; Ann. Nat. Hist. ser. 3. i. p. 276.

† De Fruct. ii. 271.

The *Tricuspidarieæ* may be divided into two sections: the first, having a baccate fruit, mostly indehiscent, comprises the genera *Aristotelia*, *Friesia*, and *Vallea*; the second, with a capsular fruit, consists of *Tricuspidaria* and *Crinodendron*,—in all, five genera. Having studied their structure with much care, I proceed to describe each genus separately.

1. Aristotelia.

This genus, established by L'Héritier upon the well known Maqui of Chile, was referred by the late Mr. Brown and De Candolle to the *Homalineæ*; by Endlicher it was made into a suborder attached to *Ternstræmiaceæ*; Von Martius also made it a suborder (*Maquinæ*), which he placed near *Pittosporeæ*; Lindley considered this suborder allied to *Philadelphiaceæ*; Reichenbach placed it in *Escallonieæ*; but Don was the first who rightly indicated its affinity with the *Elæocarpeæ*, to which alliance it unquestionably belongs. The genus for many years was confined to its single typical species; but Dr. Hooker, in his 'Flora Zelandica,' associated with it the genus *Friesia*. There are so many points of structure in the Chilean plant at variance with the several species of *Friesia*, that it appears to me this genus cannot remain amalgamated with *Aristotelia*, for the following reasons.

In *Aristotelia* the petiole is always 2-glandular at its apex; and the teeth of the leaves have each a glandular termination. In *Friesia* no indication of any gland is seen either on the leaves or petioles.

In *Aristotelia* the flowers are usually 5-merous, with a 3-celled ovary, and always hermaphrodite or else polygamous, with only a partial depauperation of the male or female organs. In *Friesia* the flowers are 4-merous, with a 4-celled ovary; and they are described as being diœcious in most instances.

In *Aristotelia* the petals are not divided at the apex, being only slightly emarginated or truncated; and the absence of this feature led botanists to believe, for a long time, that it could not belong to *Elæocarpeæ*; they are white, with a slightly yellowish tinge. In *Friesia*, on the other hand, they are more or less deeply 3-lobed at the apex, as in other *Tricuspidarieæ*, and are generally marked with a deep purple colour.

In *Aristotelia* there is a large, deep, cup-shaped disk fixed on the thickened apex of the pedicel or torus, to which the sepals are agglutinated by a broad line of attachment. In *Friesia* there is no circular disk; but in lieu of this we see four small free fleshy glands emanating from the narrow torus and placed opposite to the sepals.

In *Aristotelia* the stamens are inserted upon the pentagonal

cup-shaped disk, in the bottom of which the ovary is placed; the fifteen stamens are in five phalanges, three being fixed biserially upon each angle of the disk, two of them more internally than the other, the filaments rising out of as many prominent foveated articulations; and in this manner all the stamens are opposite to the sepals and none face the petals. In *Friesia* the twelve stamens are arranged in a single whorl opposite to the sepals and petals alike, and they are fixed around the ovary within and independent of the fleshy glands. The difference is, therefore, that in one case the stamens are borne *upon* the disk, and in the other are situated *within* the disk.

In *Aristotelia* the fruit is extremely baccate, the mesoderm being copious, fleshy, and capable of fermentation; so that the berries are used by the natives of Chile in the fabrication of a kind of wine, of which they are very fond. In *Friesia* the fruit, though indehiscent and of similar form, has a dry testaceous pericarp. It is three-celled in the former, 4-locular in the latter.

In *Aristotelia* the outer fleshy integument of the seed is furnished, below the hilum and above the chalaza, remote from both, with an enlargement in the form of a horny laminar prolongation, decurrent for some distance, and then arched over involutely; it appears like a sacciform duplicature of the integument, filled with long corneous cells. Where only one seed is perfected, this process is either superior or inferior, according as the upper or lower ovule is fertilized; when two seeds are matured, which are always superposed, the process is seen upon one seed on the right hand of the line which separates them, and upon the left in the other. This appendage is not unlike that figured by Gaertner in *Ganitrus* (*Elæocarpus serratus*), ii. p. 271, tab. 140, and is often seen in the seeds of *Elæocarpus* and *Monocera*: it has not before been noticed in *Aristotelia* by any botanist, except Prof. Agardh, who, in his 'Theor. Syst.' p. 276, alludes to it as appearing upon the "putamen." In *Friesia* the corresponding fleshy tunic is quite smooth, without any such appendage.

In *Aristotelia* the second or osseous tunic is externally quite smooth; in *Friesia* it is always very tuberculated.

It appears to me, therefore, that with so many and such prominent differences of structure, it must be conceded that *Friesia* has little to justify its amalgamation with *Aristotelia*. It offers a much closer approximation to *Vallea*.

Gay states that in *Aristotelia* the typical plant has velvety stipules, which are very caducous. I have never perceived any indications of them; and they do not appear in the drawing I made of the living plant forty-five years since.

The source of this mistake appears to me obvious; for in the axils of the leaves there is seen an oval bud consisting of several decussately imbricated, velvety, bract-like, concave, pointed, oval scales, out of which a new floriferous branch springs; and these soon fall away after the development of the branch, which is consequently marked at its base by several annular cicatrices, as may be seen in all the dried specimens.

Aristotelia, L'Hér.—*Flores* sæpius hermaphroditi, vel imperfecte polygami, rarius 4-meri. *Sepala* 5, oblonga, acuta, basi toro cupuliformi agglutinata, æstivatione valvata, demum decidua. *Petala* 5, cuneato-oblonga, apice subtruncata et leviter emarginata, sepalis paulo longiora, membranacea, æstivatione imbricata. *Discus* amplus, annulari-cupuliformis, sub-5-gonus, carnosulus, toro arcte adnatus. *Stamina* 15, in phalanges 5 disposita, in foveolis totidem elevatis supra marginem disci inserta, nempe 3 in quoque angulo biseriata, quorum 2 exteriora, omnia sepalis hoc modo absolute opposita; *filamenta* brevia, subulata, compressa, pilosa; *antheræ* lineares, 4-sulcatæ, 2-loculares, loculis collateraliter adnatis, imo breviter divaricatis, in sinu dorsaliter affixæ, erectæ, scabridulæ, apice rima brevi oblique transversa utrinque dehiscentes. *Ovarium* subglobosum, 3-sulcatum, fundo disci insitum, 3-loculare; *ovula* in quoque loculo 2, ad medium axis centralis appensa. *Stylus* erectus, teres, petalis æquilongus; *stigmata* 3, brevia, subulata, subdivaricata. *Fructus* baccatus, globosus, pisi magnitudine, pulpa copiosa gelatinosa tunicatus, 3-locularis, endocarpio dissepimentisque membranaceis, columna centrali tenui ad medium seminifera. *Semina* in quoque loculo 2 vel 1, dorso convexa, ventre angulata, et hinc ad medium *hilo* parvo signata; *integumentum externum* (arillina) nigrum, nitidum, carnosum, processu supra angulum basalem decurrente laminari galeatim inclinato subcorneo appendiculatum, intus *raphe* chordiformi brevi ad basin ab hilo descendente munitum; *integumentum secundum* osseum, ovatum, imo truncatum, hinc crassissimum et foramine in locellum vacuum pro raphes intrusione perforatum, apice mamilla parva (*micropyle*) notatum; *integumentum internum* tenuiter membranaceum, ad basin liberum, hinc *chalaza* magna orbiculari fusca signatum, apice micropyle fusco punctata; *albumen* ovatum, imo valde truncatum, copiosum, carnosum; *embryo* inclusus, paulo brevior, *cotyledonibus* ovatis, crasso-foliaceis, *radicula* tereti ad micropylen spectante 2-plo longioribus.

Arbores *Chilenses sempervirentes;* folia *subopposita, oblonga, glanduloso-serrata, petiolata;* racemi *axillares, brevissimi, pauciflori.*

1. *Aristotelia Maqui*, L'Hérit. Stirp. 31, tab. 16; Lam. Illust. t. 399; DC. Prodr. ii. 56; Gay, Chile, i. 336;—Aristotelia glandulosa, *R. & P. Syst. Fl. Per.* p. 126; *Poir. Suppl.* iii. p. 587;—frondosa, ramosissima; foliis suboppositis, late ovatis vel oblongis, imo rotundatis vel subcordatis, apice subobtusis aut breviter attenuatis, marginibus subrevolutis, dentato-serratis, dentibus glanduliferis, utrinque glabris, nisi in costa nervisque pilosulis, supra læte viridibus, nitentibus, reticulato-venosis, subtus pallidis vel glaucis; petiolo tenui, apice 2-glanduloso, supra canaliculato, limbo dimidio vel 3-plo breviore, puberulo: racemis in ramis novellis axillaribus, ramose 3–5-floris, subpuberulis.—In Chile frequentissima: *v. v. et s.*

An evergreen tree, growing to the height of 12 feet. The leaves are $2\frac{1}{2}$–3 inches long, $1\frac{1}{2}$–2 inches broad, on a petiole 1 inch long; one or two peduncles grow out of each axil, 4 lines long, each bearing on its apex three one-flowered pedicels, 3 lines long, between two minute bracts; the sepals are 1 line long, the petals $1\frac{1}{2}$ line*.

I collected also, in the province of Aconcagua, the variety *Andina*, described by Philippi (Linn. xxxiii. p. 31), and distinguished by its much thicker leaves.

2. *Aristotelia glabra*, n. sp.;—foliis oppositis, oblongis vel lanceolato-oblongis, imo acutis, apice obtusis, membranaceis, marginibus subrevolutis, integris vel obsolete glanduloso-serratis, undique glaberrimis, reticulato-venosis, subconcoloribus; petiolo tenuissimo, glabro, supra canaliculato, apice minutissime 2-glanduloso, limbo 3–4-plo breviore: racemis in ramulis novellis axillaribus, glaberrimis, rachi tenuissima, petiolo paulo longioribus, 3–4-floris.—In Chile: *v. v. et s.* (Prov. Quillota); *v. s. in herb. Mus. Brit.* (*Hort. Kew. cult.* A.D. 1779).

This is very distinct from the preceding, in its very glabrous leaves, sometimes acutely narrowed at the base, upon more slender petioles; they are 2–$2\frac{3}{4}$ inches long, $\frac{3}{4}$–$1\frac{1}{2}$ inch broad, upon a petiole 6–9 lines long; the peduncle of the raceme is 6 lines long, its pedicels 2–3 lines long, sometimes abortively with only one or two flowers.

* A drawing of this plant, with copious analytical details, will be given in my 'Contributions,' plate 80.

2. Friesia.

This genus has certainly some points of resemblance to *Aristotelia*; but the many differential characters, already enumerated, are too numerous to admit of the two genera being amalgamated together. *Aristotelia* is confined to Chile, while *Friesia* hitherto has been found only in insular positions, being distributed over New Zealand, Tasmania, and Hong Kong. Its generic features may be thus stated:—

Friesia, DC.;—Aristotelia (*in parte*), *Hook. fil.*—*Flores* dioici aut polygami. *Sepala* 4, oblonga, utrinque subobtusa, æstivatione valvata, decidua. *Petala* 4, cuneato-oblonga, apice 3-loba, lobis oblongis, rotundatis, sepalis paulo longiora, æstivatione imbricata. *Discus* e glandulis 4 squamiformibus carnosulis sepalis oppositis tori margine enatis constans, pilosus. *Stamina* 12, disco interiora, crebre uniserialia; *filamenta* brevia, compresso-subulata, apice incurva, pilosa; *antheræ* oblongæ, 4-sulcatæ, in sinu cordato basifixæ, 2-loculares, pilosulæ, primum poris 2 magnis apicalibus, demum rimis lateralibus dehiscentibus. *Ovarium* in sterilibus, quadratim disciforme, depressum, in fertilibus ovatum, toro semiimmersum, 4-loculare; ovula in quoque loculo 2; *stylus* brevis, subulatus; *stigma* obtusum, obscure 4-lobum. *Fructus* exsuccus, bacciformis, globosus, piperis mole, 4-locularis, pericarpio crustaceo, dissepimentis membranaceis. *Semina* in quoque loculo 2, superposita, angulato-triquetra, angulo centrali hilo parvo medio affixa; *integumentum externum* nitidum, crassiusculum, mesodermide gelatinosa mox siccata repletum, exappendiculatum; *integumentum secundum* osseum, extus valde tuberculatum, imo crassiore, et hinc foramine minuto in locellum parvum vacuum pro raphe intrusa perforatum; *integumentum internum* submembranaceum, coloratum, *chalaza* magna orbiculari signatum; *albumen* subovatum, imo truncatum, carnosum; *embryo* inclusus; *cotyledonibus* subfoliaceis, ovatis, *radicula* tereti ad micropylen spectante longioribus.

Arbores *Tasmanicæ*, *Nova-Zelandicæ et Chinenses*; folia *subopposita*, *ovata*, *serrata vel integra*, *petiolata*; flores *ramoso-paniculati*, *vel intra bracteas solitarii*, *subracemiformes*, *axillares*, *parvi*.

1. *Friesia peduncularis*, DC. Prodr. i. 520; Bot. Mag. lxxii. tab. 4246;—Elæocarpus peduncularis, *Lab. Nov. Holl.* ii. 15, tab. 155.—In Tasmania.
2. *Friesia racemosa*, A. Cunn. in Ann. Nat. Hist. ser. 1. vol. iv. p. 23; Hook. Icon. vii. tab. 601;—Elæocarpus dicera, *Vahl.*

Symb. iii. 67;—Dicera? serrata, *Forst. Prodr.* 227; *DC. Prodr.* i. 520; *A. Rich. Fl. Nov. Zel.* 304:—Aristotelia racemosa, *Hook. fil. Fl. N. Zel.* i. p. 33.—In Nova Zelandia.

3. *Friesia fruticosa*;—Aristotelia fruticosa, *Hook. fil. l.c.* p. 34. —In Nova Zelandia.

4. *Friesia Chinensis*, Gardn. & Champ. in Hook. Kew Journ. i. 243.—In ins. Hong Kong.

3. Vallea.

This genus, proposed by Mutis, was first established by Linnæus, in the Supplement to his 'Systema.' Its floral characters were figured and described in the 'Flora Peruviana;' and the genus was afterwards better illustrated by Kunth. Most botanists have placed *Vallea* in the *Elæocarpeæ*; but the authors of the new 'Genera Plantarum' have arranged it in their tribe *Sloaneæ*, on account of the "subligneous muricated capsule." But there is very little resemblance in the pericarp of this genus to that of *Sloanea* and its allied genera, where, in a dry capsular fruit, the valves are thick, ligneous, and densely covered with long spines or rigid hairs. It is not correct to say that the pericarp of *Vallea* is *muricated*; on the contrary, the fruit is baccate, the mesocarp being thick, soft, and fleshy, covered by a thin membranaceous epicarp, which is corrugated in the form of many fleshy obtuse tubercles; this dries upon the testaceous endocarp after the fall of the fruit, when it becomes imperfectly dehiscent at its summit. I have seen the fruit in an unripe state only, when the seeds have not been sufficiently perfected to ascertain the nature of the integuments; but a longitudinal section through the centre shows that the edges of the dissepiments are firmly agglutinated upon a solid central column that rises to three-quarters of the length of the cells, the remaining upper portions being separated by a hollow space; and it is this which limits the small extent of the apical dehiscence of the fruit when it becomes quite dried. This structure is analogous to that in *Tricuspidaria*; but there the axile column scarcely rises above the base; so that the edges of the dissepiments, being unrestrained, admit of a considerable extent of divarication of the valves. In *Aristotelia* this central column rises to two-thirds of the length of the cell; but the endocarp is of too thin a texture to give sufficient elasticity to the parts, after they become dried, to cause its dehiscence. It will appear, therefore, that *Vallea* ought to stand close to *Aristotelia*, as it possesses all the essential characters of the *Elæocarpeæ*: it has the calyx and petals of *Friesia*, a disk very different from any of the *Sloaneæ*, the stamens, ovary, style, and stigma as in *Aristo-*

telia. It has, however, one peculiarity in sometimes having stipules, which do not seem to be known in other genera of the *Elæocarpeæ*; nor do they exist in the *Sloaneæ*; but this appears to be only a partial feature in the genus.

I have drawn up an amended character of *Vallea* from my own observations.

Vallea, Mutis.—*Flores* hermaphroditi. *Sepala* 5, oblonga, acuta, marginibus lanuginosis, æstivatione valvata. *Petala* 5, sepalis paulo longiora, membranacea, obovata, fere ad medium 3-loba, marginibus supersessis, æstivatione imbricata. *Discus* crassus, in annulos 2 fossa intermedia constrictus, exteriore plano, margine undulato toro adnato, interiore subcupulæformi, margine elevato et crenulato, intervallo staminigero. *Stamina* 40, in seriebus 2, in constrictione disci crebre disposita; *filamenta* linearia, complanata, superne tenuiora, puberula, apice incurvata; *antheræ* lineares, sub-4-gonæ, antice et postice profunde sulcatæ, basifixæ, 2-loculares, apice utrinque poro obliquo angulato dehiscentes. *Ovarium* conico-rotundum, 3–4-sulcatum, 3–4-loculare, loculis 3-ovulatis; *ovula* subreniformia, axe centrali affixa, superposita: *stylus* filiformis, erectus, stamina æquans, glaber; *stigmata* 3–5, subbrevia, teretia, subdivaricata. *Fructus* baccatus, globosus (pericarpio succulento, in tubercula plurima elongata obtusa carnosa corrugato, endocarpio lævi), 3-locularis, siccus dehiscente ad apicem brevissime ac loculicide 3-valvatim aperiens: *semina* pauca, ignota.

Arbores *Neogranadenses et Peruvianæ*, *frondosæ*; folia *alterna*, *integra*, *ovato-oblonga*, *subcordata*, *integra*, *petiolata*, *interdum stipulata*, stipulis *parvis*, *reniformibus*, *geminis*; paniculi *axillares et terminales*, *pedicellis bracteatis*.

1. *Vallea stipularis*, Mutis in Linn. f. Suppl. 266; DC. Prodr. i. 520; H. B. K. v. 349, tab. 489.—In Santa Fé de Bogota: *v. s. in herb. Mus. Brit.* (Mutis).

 This plant is very well described and figured by Kunth.

2. *Vallea pubescens*, H. B. K. v. 350;—ramulis teretibus, nigrescentibus, junioribus ferrugineo-tomentosis; foliis ovato-oblongis, imo subrotundis, vix cordatis, apice subobtusis, integris, e basi 3–5-nerviis, nervis conspicuis, reticulato venosis, supra nitidis, glaberrimis, subtus flavido-glaucis, undique præsertim in axillis nervorum molliter ferrugineo-pubescentibus; petiolo tenui, fere glabro, limbo dimidio breviore; stipulis geminis, reniformibus, fere sessilibus, extus parce puberulis: paniculis axillaribus, folio paulum

brevioribus, rufo-puberulis, bis dichotome divisis, cum flore in dichotomis ; pedicellis incrassatis, bracteolis minimiis, caducis ; fructu carnoso, tuberculato, globoso, pisi majoris mole.—In Nova Granada et Peruvia : *v. s. in herb. meo*, Peru (Mathews, 3048) ; *in herb. Mus. Brit.**

3. *Vallea cordifolia*, R. & P. Syst. Fl. Per. 132 ; Prodr. 75, tab. 14 ; DC. Prodr. i. 520 ;—ramulis teretibus, junioribus rufo-tomentosis ; foliis elongato-oblongis, imo cordatis vel truncatis, sursum gradatim angustioribus, longiuscule acuminatis, marginibus sæpius sinuatis, supra obscure viridibus, nitentibus, glabris, nervis tenuibus, reticulatis, subtus fusco-ferrugineo-glaucis et undique præsertim in nervis rufo-pubescentibus ; petiolo subtenui, tereti, parce puberulo, limbo 3-plo breviore ; stipulis deficientibus et forsan nullis : paniculis in ramulis junioribus subterminalibus, pubescentibus, laxe dichotome divisis, cum flore in dichotomiis ; bracteis foliolosis ; pedicellis crassissimis ; stigmate 5-fido.—In Peruvia : *v. s. in herb. meo*, Peru (Mathews, 892) ; *in herb. Mus. Brit.*

The leaves in this species are 4–4½ inches long, 2¼–3 inches broad, on a petiole 1¾ inch long. No stipules can be discovered in any of the specimens I have seen, although DeCandolle states their presence, perhaps under a mistake : they are not mentioned by Ruiz & Pavon.

4. *Vallea glabra*, n. sp. ;—ramulis teretibus, glabris ; foliis imo truncatis (non cordatis), ovatis vel obovatis, subpanduræformibus, apice obtusule ac breviter attenuatis, integris, 3-nerviis, supra pallide viridibus, nitentibus, reticulatis, subtus pallidissime flavo-glaucis, glabris (nisi axillis nervorum quæ barbatæ sunt), nervis venisque nudis, stramineis ; petiolo tenuissimo, glaberrimo, imo apiceque paululum incrassato, limbo dimidio breviore ; manifeste exstipulatis : paniculis glaberrimis, terminalibus, bis dichotome divisis, cum flore in dichotomiis, pedicellis apice incrassatis ; sepalis glabris, marginibus intus lanatis ; stigmate 3-fido.—In Peruvia : *v. s. in herb. meo*, Prov. Chachapoyas (Mathews).

This is a distinct species, hitherto undescribed, approaching the last in the want of stipules. Its leaves are 2½–3 inches long, 1½–1¾ inch broad, on a petiole 1¼–1½ inch long. The terminal panicle is 1½ inch long, pedicels 2–2½ lines long ; sepals 2 lines long ; stigma 3-fid.

* This species, with ample details, will be figured in the forthcoming volume of my 'Contributions,' pl. 81.

4. Tricuspidaria.

There are many points of analogy between this genus and *Aristotelia*; but it differs in its solitary and much larger flowers upon lengthened peduncles, in their being always hermaphrodite, in having a tubular calyx, more fleshy petals, longer stamens arranged uniserially on the summit of a tall cylindrical disk or gynophore that supports the ovary, in its long subulate style, its capsular fruit, and in its seeds. In *Aristotelia* the hilum is upon the middle of the ventral edge of the seed; in *Tricuspidaria* it is at one extremity, the other being deficient of the horny appendage. The outer tunic is less fleshy, more friable, and easily separating when dry, leaving the chord of the raphe upon the second integument or bony shell, extending from one extremity to the other, where it is lost in the large truncated chalaza. There are two species, both natives of Chile, one of which I examined attentively, many years ago, in the living state. The following is an amended and more amplified generic character, founded upon my own observations.

Tricuspidaria, R. & P.—*Flores* hermaphroditi. *Calyx* urceolato-tubulosus, submembranaceus, margine breviter sinuato-5-dentatus, demum irregulariter dirupto-partitus et deciduus. *Petala* 5, æqualia, cuneato-oblonga, concava, imo subsaccata, intus usque ad medium carinata, apice in denticulos 3 acutos incisa, calyce 3-plo longiora, carnosa, imo disci inserta, æstivatione e marginibus longitudinaliter late inflexis introplicato-valvata, decidua. *Discus* in forma gynophori, alte cylindraceus, profunde 10-sulcatus, ovarium fulciens, persistens. *Stamina* 15, petalis æquilonga, uniserialiter summo disci inserta, ovarium crebre circumstantia; *filamenta* filiformia, compressa, pilosula, superne paulo divaricatim curvata; *antheræ* his dimidio breviores, lineares, 4-sulcatæ, summo filamentorum geniculatim affixæ, apice conniventes, collateraliter 2-loculares, loculis vertice e poris 2 confluentibus, brevissime 2-valvatim dehiscentes. *Ovarium* disco superpositum, elongatum, apice conico-subcylindricum, 3–4-sulcatum, 3–4-loculare: *ovula* in quovis loculo 12–16, per paria angulo centrali horizontaliter affixa; *stylus* ovario æquilongus, tenuiter subulatus; *stigma* obtusulum aut vix ullum. *Capsula* ovata, 3–4-quetra, angulis undulatis, stylo acuminata, disco persistente stipitata, 3–4-locularis, ultra medium loculicide patentim dehiscens, dissepimentis medio valvarum affixis, ad axin solutis, margine seminiferis, columna centrali nulla. *Semina* in quoque loculo 4–8, biserialia, obovata, subangulata, una extremitate *hilo* minimo notata,

altera rotundata; *integumentum externum* nitidum, nigrum, carnosulum, sicco fragile et facile desiliente, *raphen* ab hilo ad chalazam in forma chordæ longitudinalis includens; *tunica secunda* obovata, subossea, imo incrassata et truncata, hinc foramine intra locellum vacuum (pro raphes transitu) perforata, apice mamilla parva apiculata, lævis, opaca, pallida; *integumentum internum* submembranaceum, fulvum, imo chalaza magna orbiculari notatum, apice micropyle punctatum: *albumen* obovatum, prope chalazam truncatum, carnosum; *embryo* inclusus, fere æquilongus, *cotyledonibus* ovatis, compressis, *radicula* tereti ad hilum spectante 4-plo longioribus.

Arbores *Chilenses*, *sempervirentes*, *frondosæ;* folia *suboppositа*, *oblonga*, *glanduloso-serrata*, *breviter petiolata:* flores *speciosi*, *albi*, *majusculi*, *solitarii*, *axillares*, *longe pedunculati.*

1. *Tricuspidaria dependens*, R. & P. Prodr. Fl. Per. 64, tab. 36, Syst. p. 112; DC. Prodr. i. p. 520;—Tricuspis dependens, *Pers. Ench.* ii. p. 9;—Arbor frondosa, ramis divergentibus, alternis, rarius suboppositis, teretibus, glabris, ultimis brevibus, rigide spiniformibus et foliolosis; foliis subalternis, rarius oppositis, subparvis, ovatis, utrinque obtusis, coriaceis, marginibus subrevolutis, crebre glanduloso-serratis, supra læte viridibus, glaberrimis, subtus pulverulento-glaucis; petiolo brevissimo, glabro, limbo 10-plo breviore: floribus axillaribus, solitariis, subbreviter pedunculatis, folio paulo brevioribus; calyce irregulariter rupto, demum deciduo; petalis subcoloratis, extus pulverulento-tomentosis: capsula disco stipitata, depresso-trigonoidea, lævi, subcarnosa, valvarum marginibus planis.—In Chile prov. australioribus: *v. s. in herb. Mus. Brit.* (spec. typ. Ruiz & Pav.); Concepcion (Dombey).

There can be no doubt in regard to the identity of this species, with which the following has been confounded. It is an evergreen tree, about 20 feet high, with a trunk about a foot in diameter, growing in moist places and on the sides of rivers in the provinces of Concepcion and Itata, with pendent branches which reach the ground and there sometimes take root; it has much smaller leaves than the following species, more divaricating and shorter branchlets (often like leaf-bearing spines), extremely short petioles, and smaller flowers. The leaves are generally 9 lines, sometimes 15 lines long, 6–8 lines broad, on a petiole 1–1¼ line long; the peduncle is 8 or 9 lines long; the flowers have a very sweet smell; the calyx, 2 lines long and broad, becomes lacerated to the base, and soon falls off;

the petals are darker, 6 or 7 lines long; the filaments are 3 lines, the anthers 2 lines long; the ovary is conically oblong, somewhat puberulous, and, together with its long pointed subulate style, is 5 lines long; the capsule is 5 lines high, 7 lines broad, smooth and subfleshy (not transversely corrugated), 3-valved, the margins of the valves being straight and flattened.

2. *Tricuspidaria Patagua*, nob.;—Tricuspidaria dependens, *Hook.* (*non R. & P.*) *Bot. Misc.* iii. p. 156; *Gay*, *Chile*, i. p. 338;—Crinodendron Patagua, *Mol.* (*non Hook.*) *Hist. Chile*, pp. 146 & 290; *Cav. Diss.* 300, tab. 158;—Arbor frondosa, ramis elongatis, subascendentibus, teretibus, striatellis, cinereis, brevissime tomentellis; foliis sæpius oppositis, oblongo vel lanceolato-oblongis, imo cuneatis, apice rotundatis aut obtusis, coriaceis, marginibus subrevolutis, sinuato-serratis, dentibus glanduloso-mucronulatis, supra pallide viridibus, glaberrimis, nitidis, subtus glaucescentibus et præsertim in nervis prominulis arcuatim nexis parce puberulis, petiolo canaliculato, flavido-pubescente, limbo 8-plo breviore: floribus solitariis, axillaribus, longe pedunculatis, folio paulo brevioribus; calyce campanulato, margine demum lacerato, ab ovario in forma annulari secedente pedunculum circumdante prolapso; petalis niveis, carnosis, majusculis, intus usque ad medium valde carinatis, marginibus introplicatis; capsula disco stipitata, ovata, utrinque acuta, subtrialata, marginibus valde undulatis, coriacea, transversim corrugata, seminibus nigris, nitentibus.—In Chile prov. centralibus: *v. v. et sicc.* (Bridges, 159).

This is a handsome tree, about 30 feet high, also evergreen, growing in drier situations in all the central provinces, extending even into the deep valleys of the Cordillera: it produces a timber of much utility and of considerable size—according to Molina, sometimes 7 feet in diameter; but I never heard of any approaching so large a size. Its leaves are from $1\frac{1}{4}$–$2\frac{1}{2}$ inches long, 8–12 lines broad, on a petiole 3 lines long; the peduncle in flower is 8–10 lines long, in fruit 12 lines long, gradually thickening upwards, and 5-sulcate; the calyx is $1\frac{1}{2}$ line long, 2 lines in diameter, seceding from the summit of the pedicel and remaining strung upon it, in the form of a fimbriated annular disk; the petals are 7–8 lines long; the capsule is 6 lines long and broad, pointed at each extremity, opening upon the sharp, sutural, much undulated edges of the valves, which, curving back horizontally, show the seeds attached to each side of the margin of the

dissepiments; the pyriform seeds are 2 lines long, $1\frac{1}{2}$ line in diameter *.

5. Crinodendron.

This name was given to the well-known Patagua of Chile by Molina, who described it so imperfectly that Ruiz and Pavon did not recognize it when they founded their genus *Tricuspidaria* upon the same plant. Molina gave Cavanilles a rough drawing, showing the flower and seed, made from memory, which the latter described and figured in his 'Dissertationes,' the characters there assigned to it being altogether erroneous. Sir William Hooker, in 1833, described a plant from the island of Chiloe, collected by Cuming, which he supposed to be the same as that incorrectly described by Molina and Cavanilles, and accordingly named it *Crinodendron Patagua*. In giving an outline of its generic character, he wrongly described the flower as having no calyx, which had fallen away from Cuming's specimens; the inflection of the petals was not noticed; and the remarkable glands were not observed upon the disk, which was figured as being simply columnar. Gay, in his 'History of Chile,' erroneously describes the calyx; but he gives an account of the structure of the fruit, which was not known previously. *Crinodendron* cannot be said to have existed as a genus until Sir William Hooker first established it in his 'Botanical Miscellany;' and he, perceiving its near affinity to *Tricuspidaria*, placed it in the *Elæocarpeæ*, notwithstanding the then apparently discordant characters of its floral envelopes. De Candolle has not noticed the genus; but Endlicher placed it in his tribe *Tricuspidariæ*, in association with *Vallea* and *Tricuspidaria*. Bentham and Hooker, in their 'Nova Genera,' have regarded it as a synonym of *Tricuspidaria*, evidently unaware of the characters which separate it from that genus. The following is an amended diagnosis, according to my own observations, as far as regards the floral structure; not having seen the ripe fruit, I have copied the details in that respect from Gay's work, where alone it is described.

Crinodendron, Hook. (non Mol. nec Cavan.).—*Flores* hermaphroditi. *Sepala* 3, obovata, apice 2-dentata, dentibus rotundatis, æqualia, parallele nervosa, utrinque adpresse pilosa, æstivatione paulo imbricata, valde caduca. *Petala* 5, oblonga, sepalis plusquam duplo longiora, extus convexa, imo breviter saccata, lateribus inflexis, apice breviter et

* A figure of this species, with full structural details, will be shown in my 'Contributions,' plate 82.

acute 3-dentata, carnosula, suberecta, extus glabra, intus in nervis parallelis prominulis pilosula, æstivatione introflexo-plicata, dentibus valvatis, mox decidua. *Discus* in forma gynophori late columnaris, centralis, extus in glandulas 10 parallelas oblongo-ovatas inciso-sulcatus, coloratus, persistens. *Stamina* 20, æqualia, summo disci circa ovarium uniseriatim inserta; *filamenta* tenuissime linearia, imo paulo latiora, subcurvata, brevissime hispida; *antheræ* longe lineares, 4-sulcatæ, scabridulæ, geniculatim basifixæ, apicibus conniventes, antice et postice profunde sulcatæ, 2-loculares, vertice e poris 2 confluentibus brevissime 2-valvatim serius longitudinaliter dehiscentes. *Pollen* minute globosum. *Ovarium* ovatum, disco stipitatum, sulcatum, velutino-pilosum, 5-loculare; *ovula* 24–30 in quovis loculo, crebre 3-seriatim axi centrali affixa: *stylus* subulatus, erectus, subtenuis, 5-sulcatus, subglaber; *stigma* obsoletum. *Capsula* (sec. cl. Gay) subrotunda, grosse bullata, coriacea, velutina, 4–5-locularis, loculicide dehiscens; *semina* in quovis loculo 3–4, superposita, axi affixa, rotundo-pyriformia, subangulata; *testa* crustacea: *embryo* in albumine subtenui corneo-carnoso, orthotropus; *cotyledones* plani, suborbiculares, *radicula* brevi, supera.

Arbor *Chilensis et Chiloensis*, *frondosa*, *sempervirens*; folia *sublanceolata*, *glanduloso-serrata*, *breviter petiolata*: flores *speciosi*, *aurantiaci*, *majusculi*, *solitarii*, *axillares*, *longissime pedunculati*.

1. *Crinodendron Hookerianum*, C. Gay, Flor. Chile, i. p. 341; —Crinodendron Patagua, *Hook.* (*non Mol. nec Cav.*) *Bot. Misc.* iii. p. 156, tab. 100;—Arbor frondosa; foliis subopositis vel subternis, lanceolato-oblongis, utrinque obtusis aut subacutis, marginibus valde revolutis, remote serratis, dentibus longe glanduloso-mucronatis, supra pallide viridibus, subtus flavido-glaucis, in axillis nervorum fasciculato-barbatis, nervis arcuatis prominentibus, petiolo limbo 12-plo breviore costaque pubescente: floribus axillaribus, solitariis, cum pedunculo apice incrassato pubescente 2–3-plo longiore folia subæquantibus; sepalis utrinque puberulis; petalis carnosulis, aurantiacis, glabris, sepalisque mox deciduis; ovario flavide tomentoso; stylo subulato, ad medium piloso; capsula ovato-globosa, majuscula, grosse bullata, tomentosa, 4–5-sulcata, 4–5-loculari, apice breviter loculicide dehiscente; seminibus in loculis 3 vel 4, majusculis; testa crustacea.—In Chile prov. Valdivia et in insula Chiloe: *v. s. in herb. meo*, *Mus. Brit.*, *et Hook.*, Valdivia (Bridges, 613); Chiloë (Capt. King; Cuming, 22).

An evergreen tree, 8–16 feet high, with a trunk 8 inches in diameter: leaves $1\frac{3}{4}$–4 inches long, 5–12 lines broad, on a petiole $1\frac{1}{2}$–2 lines long; peduncle $1\frac{1}{4}$–$1\frac{3}{4}$ inch long, gradually thickening to the summit; sepals 4 lines long, 3 lines broad, free and attached to the margin of the thickened apex of the peduncle, each with seven parallel nervures; petals 9–11 lines long, 4–5 lines broad, including the inflected margins, with three apical teeth 1 line long, glabrous; columnar disk 1 line high, 2 lines in diam., glabrous; filaments 3 lines, anthers 5 lines long; scabridly rugulose; ovary 3 lines long, 2 lines broad; style 4–7 lines long; capsule 8–10 lines in diameter; seeds at least 2 lines in diameter, attached to the central column*.

VII. — *Notes on the Palæozoic Bivalved Entomostraca. No. VIII. Some Lower-Silurian Species from the Chair of Kildare, Ireland.* By Prof. T. Rupert Jones, F.G.S., and Dr. H. B. Holl, F.G.S.

[Plate VII.]

In 1863 Mr. W. H. Baily, F.G.S., Palæontologist of the Geological Survey of Ireland, sent us, from the mountain near Kildare known as the Chair of Kildare†, some of the grey, crystalline, encrinital limestone, of "Caradoc-Bala" age, containing the minute fossils referred to by Prof. M'Coy, in Sir R. Griffith's 'Synopsis of the Silurian Fossils of Ireland,' p. 58, as *Cythere phaseolus* of Hisinger. In 1865 Mr. Joseph Wright, F.G.S., of Cork, visiting the Chair of Kildare, brought away a quantity of this limestone to examine at his leisure; and having broken it up and picked out the separate fossils, he found many of these little Entomostraca, and sent us a liberal supply of them for examination. These specimens are all smooth calcareous representatives of closed carapaces: they may be said to consist of the carapace-valves replaced by calcite and filled with the same; while a very thin film of pulverulent calcareous material sometimes represents the outermost portion (or surface) of the valves.

It has been difficult to find alliances for these Lower-Silurian Entomostraca, simple as they are in form and structure; but since our determination of the Silurian *Primitiæ* of the

* A representation of this plant, with particulars of its floral structure, will be seen in plate 83 A of my 'Contributions.'

† See the explanatory memoir entitled 'Data and Descriptions to accompany Quarter-Sheet 35 N.E. of the Map of the Geol. Survey of Ireland,' 1858.

Malverns and elsewhere, described in the 'Annals Nat. Hist.'* ser. 3. vol. xvi. (1865), pp. 414–425, pl. 13, we have a clearer view of the probable relationship of some of these specimens from Kildare; whilst others of them fall into the groups of *Cythere* and *Bairdia*, as recognized by the shape of the carapace-valves. *Primitia* is a characteristically Silurian genus† (see Ann. Nat. Hist. *l. c.*); and now *Cythere* and *Bairdia* are shown to have existed at that early period, judging from fossil carapaces, such as already have been accepted as evidence of the persistency of these genera from the Upper-Palæozoic (Carboniferous) times to the present day.

1. *Primitia Maccoyii*‡, Salter, sp. Pl. VII. figs. 1 *a–c*, 2 *a & b*, 3 *a–e*.

Cythere phaseolus, M'Coy (not of Hisinger), Synops. Sil. Foss. Ireland, 1846, p. 58.

Cythere Maccoyii, Salter, in Morris's Catal. Brit. Foss. 2nd edit. 1854, p. 105.

Cythere Maccoyii, ("Forbes, n. s.?"), Baily, Descript. Quarter-Sheet 35 N.E. Geol. Surv. Ireland, 1858, p. 10.

Cythere? phaseolus§ (M'Coy, not of Hisinger), Salter, in Murchison's 'Siluria,' 2nd edit. 1859, p. 538, and 3rd edit. 1867, p. 517.

Carapace like a bean, smooth, subovate, swollen in the middle and equally compressed at the ends; somewhat Leperditioid in outline, having a nearly straight dorsal line and slightly sloping antero- and postero-dorsal margins, and being somewhat narrower at one extremity than at the other. Dorsal profile acute-oval (in some specimens rather acute-ovate). At the middle third of the hinge-line the edge of each valve is suddenly depressed, and the boundary of the inflection is rounded in the young and slightly ridged in the old specimens. The ventral border of each valve is thickened with a rim, which is doubled in large and aged individuals.

* In this paper on *Primitiæ*, at p. 417, the name "Schrenk" is twice printed by mistake for Schmidt; also in the footnote at p. 424.

† To the already recorded *Primitiæ* (Ann. Nat. Hist. *l. c.*) we wish to add two, namely, (1) *Cytheropsis rugosa*, Jones (Ann. Nat. Hist. ser. 3. vol. i. p. 249, pl. 10. fig. 5, figured upside down) from the Trenton Limestone of Canada, which in shape much resembles *Primitia semicircularis*, J. & H., whilst its punctation is such as we see in *P. variolata*, J. & H.; (2) *Leperditia Solvensis*, Jones, a very small Leperditioid Entomostracan, without eye-tubercle or muscle-spot, from the Lower Lingula-flags, of Upper Solva, on the west side of Solva Harbour, near St. David's, South Wales (see Annals Nat. Hist. ser. 2. vol. xvii. p. 95, pl. 7. fig. 16; and Quart. Journ. Geol. Soc. vol. xx. p. 238).

‡ For the relative sizes of the *Primitiæ* &c. described in this paper, see further on, page 58.

§ Specimens from the Chair of Kildare are also referred to, in the 'Catal. Collect. Fossils Mus. Pract. Geol.' 1865, p. 7, as "*Cythere phaseolus*, case 7, tablet 37, specimen 15."

As one valve does not overlap the other in this Entomostracan, it is not a *Leperditia*; and the absence of both eye-spot and muscle-spot also distinguishes it from that form and the allied *Isochilina*. The acutely elliptical depression of the dorsal margins and the ventral rims remind us of similar features in *Primitia cristata*, *P. umbilicata*, and *P. tersa* (Ann. Nat. Hist. *l. c.* pl. 13. figs. 1–3); and a ventral rim is characteristic also of other *Primitiæ*, whether the median pit or furrow is present or not.

P. Maccoyii is very abundant in the limestone of the Chair of Kildare.

Several years since, Mr. Salter intimated that this fossil could not be the same as Hisinger's *Cythere phaseolus*. The latter, we know, is a *Leperditia* closely related to (or the young of) *L. Balthica*; and, though figured roughly in Hisinger's 'Lethæa Suecica' (pl. 1. fig. 1), with a mere ovate outline (as, indeed, *L. Balthica* also was at first), it is really Leperditioid in shape, and has other characters of the genus.

An individual *P. Maccoyii* is present in one of the specimens of Bala-Caradoc limestone from Aldeans*, on the Stincher (or Stinchar) River, in Ayrshire†, preserved in the Woodwardian Museum at Cambridge, and, indeed, appears to have been noticed, though not recognized, by Prof. M'Coy (see Ann. Nat. Hist. ser. 2. vol. viii. p. 387; and further on, p. 60).

In the equivalent limestone of Keisley, in Westmoreland, which has a close affinity, both in fossils and mineral character, with that of the Chair of Kildare, *P. Maccoyii* has been discovered by Prof. Harkness (see his account of the Lower Silurian Rocks of Westmoreland, Quart. Journ. Geol. Soc. vol. xxi. pp. 243 &c.).

2. *Primitia Sancti-Patricii*, n. sp. Pl. VII. figs. 4 *a*, 4 *b*.

Carapace smooth, almost semicircular in outline, convex in the middle and nearly equally compressed towards the margin all round; back very slightly arched, rounded at the end of the hinge-line; one extremity rather more broadly curved than the other; ventral margin fully convex, and bordered (especially posteriorly) with a faint rim where the edge of the valve turns inward. Dorsal profile acute-oval.

Rather more semicircular than *P. obsoleta*, this Irish species differs from it also in having less of the marginal rim and no sulcus, and in being more oval than ovate in the profile of the closed valves. Indeed it seems to be intermediate between *P.*

* Also written Aldens and Aldons.

† Rep. Brit. Assoc. for 1850, Trans. Sect. p. 107; Quart. Journ. Geol. Soc. vol. viii. (1851) pp. 139 &c.; and 'Siluria,' 3rd edit. 1867, p. 156.

obsoleta and *P. ovata*, both of Scandinavian origin (see Ann. Nat. Hist. ser. 3. vol. xvi. pl. 13. figs. 12 & 13). Rare.

1. *Cythere Wrightiana*, sp. nov. Pl. VII. figs. 5 *a*, 5 *b*.

Carapace smooth, elongate-reniform or subcylindrical, like a haricot bean; ends nearly equal in curvature and compression; but one (the anterior) is rather more elliptical and rather more compressed than the other; dorsal line elliptic; ventral line slightly sinuate, being somewhat incurved at the middle. Dorsal profile elongate-ovate. Rare.

Modifications of this shape are not uncommon among the carapaces of *Cythere*, both recent and fossil; but we cannot definitely match this form with any known species. The same may be said of those that follow.

We have named this old *Cythere* after Mr. Joseph Wright, F.G.S., to whose care we owe the many well-preserved specimens of Entomostraca that we have seen from Kildare.

2. *Cythere Jukesiana*, sp. nov. Pl. VII. figs. 6 *a*, 6 *b*.

Carapace subcylindrical, but very much narrower and rather more compressed at one end (anterior) than at the other,—in fact strongly tapering from the posterior third forwards. The back is arched behind the middle, and the ventral margin is incurved a little in front of the middle. Ends elliptical in curve; the posterior is broader than the anterior extremity. Dorsal profile subovate, acute at the ends and compressed at the sides. Rare.

Named after the Director of the Geological Survey of Ireland.

3. *Cythere Bailyana*, sp. nov. Pl. VII. figs. 7 *a*, 7 *b*.

Carapace smooth, somewhat bean-shaped; straight on the back, rounded nearly equally and attenuated at the ends; incurved and compressed at the middle of the ventral region. Dorsal profile acute-oval, laterally compressed. Rare.

Named after the Palæontologist of the Geological Survey of Ireland.

4. *Cythere Harknessiana*, sp. nov. Pl. VII. figs. 8 *a*, 8 *b*.

Carapace smooth, nearly ovate; the back is more strongly arched than the ventral edge; and these opposite margins have their greatest convexity in an oblique direction one to the other—that of the ventral margin being in advance of the middle, and that of the back rather behind it. Dorsal profile nearly oval, but subacute at the ends. Rare.

We dedicate this Lower-Silurian species to Prof. Harkness, F.R.S., of Queen's College, Cork, who has laboured on the Palæozoic rocks of Ireland and the north of England.

1. *Bairdia Murchisoniana*, sp. nov. Pl. VII. figs. 9 *a*, 9 *b*.

Carapace smooth, almost subcylindrical, arcuate, tapering, and compressed at the ends. Anterior end rounded obliquely, posterior obtusely pointed. Dorsal profile narrow and acutely oval. Rare.

This elegant *Bairdia*, resembling to some extent other elongate forms of *Bairdia*, but wanting the broadly produced and hatchet-shaped anterior end of the Carboniferous and Permian *B. curta* and its varieties*, is dedicated to Sir R. I. Murchison, Bart., whose Silurian researches have so greatly aided in elucidating the structure and history of the old rocks of Ireland, as well as of Great Britain and many other parts of the world.

2. *Bairdia Griffithiana*, sp. nov. Pl. VII. figs. 10 *a*, 10 *b*.

Carapace smooth, subdeltoid; back obliquely arched, with steep unequal slopes to the extremities, the anterior of which makes an acute angle with the ventral border, whilst the posterior is obtusely rounded. Ventral border slightly sinuate. Ventral profile acute-ovate, compressed. Rare.

The name of Sir Richard Griffith, Bart, the veteran Geologist of Ireland, is attached to this species.

3. *Bairdia Salteriana*, sp. nov. Pl. VII. figs. 11 *a*, 11 *b*.

Carapace smooth, swollen, subovate; with angular compressed ends, and an acute-oval profile. Rare. To some extent this species resembles a subrhombical variety of *B. plebeia* (see "Permian Entomostraca," in the Transact. Tyneside Nat. Field-Club, vol. iv. pl. 11. fig. 12 *a*).

Named in honour of J. W. Salter, Esq., F.G.S., whose researches among Silurian Fossils are well known.

Measurements.

	Length.	Width.	Thickness.
	inch.	inch.	inch.
Primitia Maccoyii, *old*	0·09	0·0575	0·045
„ „ *intermediate*	0·07	0·0525	
„ „ *young*	0·0375	0·025	0·02
„ Sancti-Patricii.....	0·05	0·04	0·025
Cythere Wrightiana	0·0675	0·0325	0·0275
„ Bailyana.....	0·055	0·0225 / 0·025	0·015
„ Jukesiana	0·07	0·0275	0·0225
„ Harknessiana.....	0·0575	0·0325	0·0325
Bairdia Murchisoniana	0·0525	0·0225	0·0175
„ Griffithiana.....	0·04	0·0225 nearly	0·015 to 0·0175
„ Salteriana	0·045	0·0225	0·0225 nearly

* Ann. Nat. Hist. ser. 3. vol. xviii. p. 42.

From the "Caradoc" or "Bala-Caradoc" formation there are some other Bivalved Entomostraca known, namely:—

1. *Primitia strangulata*, Salter, sp. Ann. Nat. Hist. ser. 3. vol. xvi. p. 416; from Coniston Waterhead, Lancashire; and found also in the "Brandschiefer"* of the Baltic Provinces, according to Schmidt.

1 *a*. —— ——, var. *α*, *op. cit.* p. 417. Robeston Wathen, Pembrokeshire.

2. —— *Salteriana*, J. & H., *op. cit.* p. 417. Sholes Hook, Haverfordwest; in the "Brandschiefer" of Wannemois and in the Borkholm bed (Schmidt).

2 *a*. —— ——, var. *crenulata*, Schmidt, *op. cit.* p. 417. Paggar and Borkholm.

3. —— *semicordata*, J. & H., *op. cit.* p. 417. Sholes Hook, Pembrokeshire.

4. —— *matutina*, J. & H., *op. cit.* p. 418. Cheney Longville, Shropshire.

5. —— *simplex*, Jones, *op. cit.* p. 417. Harnage†, Shropshire; and in the Llandeilo schists of Busaco, Portugal.

6. —— *bicornis*, Jones, *op. cit.* p. 420. Harnage.

7. —— *nana*, J. & H., *op. cit.* p. 420. Harnage.

8. *Leperditia* [*Primitia*?] *minuta* (Eichwald, sp.), Schmidt, Untersuchungen, p. 194; in the Brandschiefer and the Wessenberg and Borkholm beds.

9. —— [——?] *brachynotha*, Schmidt, Untersuch. p. 195; Borkholm.

10. —— [——?] *obliqua*, Schmidt, Untersuch. p. 195; Borkholm.

11. *Beyrichia complicata*, Salter. Abermarchant &c. (See Ann. Nat. Hist. ser. 2. vol. xvi. pp. 164 &c.) This species occurs also in the Llandeilo rocks of Wales, and in the "Brandschiefer" of the Baltic Provinces (Schmidt).

12. —— *affinis*‡, Jones. Tramore, Ireland. *Op. cit.* p. 171.

* This *Brandschiefer* is in the uppermost part of the lowest Silurian group of the Baltic Provinces of Russia; and the Borkholm bed lies higher up, being the uppermost of the Lower Silurian beds. See F. Schmidt's 'Untersuchungen über die Silurische Formation von Esthland, Nord-Livland und Oesel,' 8vo, Dorpat, 1858; and Quart. Journ. Geol. Soc. vol. xiv. pp. 43 *et seq.*

† The Lower Silurian schists at Harnage (near Shrewsbury, in Shropshire), which yield these little Entomostracans, are regarded by the Geological Surveyors as belonging to the Caradoc-Bala formation. Mr. Salter, however, thinks that they may be of Llandeilo age.

‡ In the last edition of 'Siluria,' at page 516, this species is placed by mistake in the Llandeilo column of the Table of Silurian Fossils, and *B. Barrandiana* (a Llandeilo fossil) in the Caradoc Column.

13. *Beyrichia Wilckensiana*, Jones, *op. cit.* p. 89. Horderley, Shropshire.
14. *Cythere Aldensis*, M'Coy, sp. Aldeans, Ayrshire. Respecting this last species it is advisable to give here all the particulars we know of it.

Cythere Aldensis, M'Coy, sp. Pl. VII. fig. 12.

Cytheropsis, n. sp. M'Coy, 1851. Rep. Brit. Assoc. for 1850, Trans. Sect. p. 107.
Cytheropsis Aldensis, M'Coy, 1851. Ann. N. Hist. ser. 2. vol. viii. p. 387.
Cytheropsis Aldensis, M'Coy, 1852. Syst. Descr. Pal. Foss. Geol. Mus. Cambridge, pl. 1 L. fig. 2.
Cytheropsis Aldensis (M'Coy), Salter, 1859. In Murchison's 'Siluria,' 2nd edit. p. 539.
Cythere? Aldensis (M'Coy, sp.), Jones, 1867. In Murchison's 'Siluria,' 3rd edit. p. 517.

In his memoir "On some New Cambro-Silurian Fossils," 1851 (Ann. Nat. Hist. *l. c.*), Prof. M'Coy thus describes this species:—

"Arcuato-oblong, dorsal margin much arched, greatest convexity about the middle, sloping more towards the anterior, which is slightly smaller than the posterior end; posterior end broadly arched, anterior end obtusely pointed; a concave flattened sinus, rather more than half the length of the shell, in the ventral margin, rather nearer to the anterior than the posterior end; an obscure roughened spot slightly nearer to the anterior than the posterior end, and slightly nearer to the dorsal than the ventral margin; valves moderately and evenly gibbous; surface very minutely punctured, under a strong lens. Length $1\frac{1}{2}$ millimetre, depth about two-thirds the length.

"This little species is accompanied by a more elongate, oblong, less arched form, of greater rarity, which may either be a distinct species or the male.

"Extremely abundant in the dark earthy limestone of Aldens, Ayrshire."

In the Woodwardian Museum at Cambridge are preserved some specimens of the "Lower Bala" Limestone of Aldeans, collected by Prof. Sedgwick in 1850, and containing several (six or seven) small Bivalved Entomostraca, one of which Prof. M'Coy described as above, and figured in the Brit. Pal. Foss. Camb. Mus. part 2. fasc. 1. pl. 1 L. fig. 2. Through the courtesy of Mr. Harry Seeley, one of us has carefully examined these specimens. They are all imbedded to a greater or less extent in the matrix; and there are at least two distinct forms. One of these we refer to *P. Maccoyii* (see above, p. 56); and the most striking of the others is the specimen figured by Prof. M'Coy. What appears as an obscure tubercle, however,

on the figure is an exaggerated feature, and without importance; in other respects the specimen somewhat resembles our new *Cythere Jukesiana*, but it is much shorter in proportion and more arched. It also approaches some of the *Bairdiæ* in shape; but its narrow (anterior) extremity has the curvature of a *Cythere*, and is markedly deficient in the peculiar up-turned hatchet-like edge characteristic of *Bairdia*.

C. Aldensis is smaller ($\frac{1}{12}$ inch long) and less convex than the specimen of *Primitia Maccoyii* associated with it in the same limestone.

The name "*Cytheropsis*" has been applied to this and other Palæozoic Entomostraca*. With regard to this term as a generic appellation, we once thought it useful in classifying those Palæozoic Entomostraca that do not closely assimilate either to *Leperditia* or *Beyrichia*, but in outline and size resemble many of the *Cytheræ* of existing seas, though differing from them in having tubercles, relatively thick valves, or other distinctive features (Ann. Nat. Hist. ser. 3. vol. i. p. 249). The establishment, however, of the natural group of *Primitiæ* enables us to bring together several of the "simple *Beyrichiæ*," some of the dubious Leperditioid forms, and nearly all the so-called *Cytheropses*. Indeed of the known species referred to *Cytheropsis* there remain only *C. rugosa* (Jones, Ann. Nat. Hist. ser. 3. vol. i. p. 249, pl. 10. fig. 5), which is probably a *Primitia*, figured upside down, and *C. siliqua* (Jones, *op. cit.* fig. 6), which, perhaps, like some of the Kildare specimens, is a *Cythere* or a *Macrocypris*. Excepting the relatively greater thickness of the valves in some of them (and that is more apparent than real), there is nothing to indicate that these old Entomostraca, which "*Cytheropsis*" was intended to comprise, differed from what now exist as *Cytheræ*, *Bairdiæ*, *Macrocyprides*, &c. The so-called *Cytheropses* of the Carboniferous formations have already been shown to belong to *Leperditia Okeni*, &c. (see Ann. Nat. Hist. ser. 3. vol. xviii. p. 35).

EXPLANATION OF PLATE VII.

Fig. 1. *Primitia Maccoyii* (full-grown): *a*, right valve; *b*, dorsal, and *c*, ventral aspect.

Fig. 2. *P. Maccoyii* (intermediate stage of growth): *a*, left valve; *b*, ventral aspect.

Fig. 3. *P. Maccoyii* (young): *a*, left valve; *b*, ventral aspect; *c*, end view.

* "*Cytheropsis*" has also been applied to a group of recent *Cytheridæ* by G. O. Sars in 1865; but G. S. Brady proposes *Eucythere* in its place for these living forms.

Fig. 4. *P. Sancti-Patricii*: *a*, right valve; *b*, dorsal aspect.
Fig. 5. *Cythere Wrightiana*: *a*, left valve; *b*, ventral view.
Fig. 6. *C. Bailyana*: *a*, right valve; *b*, dorsal view.
Fig. 7. *C. Jukesiana*: *a*, right valve; *b*, ventral aspect.
Fig. 8. *C. Harknessiana*: *a*, right valve; *b*, dorsal aspect.
Fig. 9. *Bairdia Murchisoniana*: *a*, left valve; *b*, ventral view.
Fig. 10. *B. Griffithiana*: *a*, left valve; *b*, ventral view.
Fig. 11. *B. Salteriana*: *a*, right valve; *b*, ventral view.
Fig. 12. *Cythere Aldensis*: right valve.

BIBLIOGRAPHICAL NOTICE.

On Subaërial Denudation, and on Cliffs and Escarpments of the Chalk and the Lower Tertiary Beds. By William Whitaker, B.A., F.G.S., &c. 8vo, pp. 27. Hertford, 1867.

"For some years," writes Mr. Whitaker, in this reprint from the 'Geological Magazine, "geologists have more or less agreed in the view that the present features of the earth, whether hill, valley, or plain (with some small exceptions, as volcanic outbursts), have been formed *directly* by denudation; though *indirectly* disturbances, whether faults, upheavals, or sinkings, have of course had their effect in determining the flow, so to speak, of the denuding agent."

Of late much discussion has been held on the comparative effect of the two forces, disturbance and denudation, and on the relative extent to which sea-action on the one hand and atmospheric agencies on the other have worn away the earth's surface and carved its rocks into their present form.

Although the action, simple or combined, of frost, avalanches, glaciers, icebergs, coast-ice, river-ice, rain, snow-water, springs, torrents, and rivers, has never been ignored by geologists since their science took a systematic form, yet doubtless they have been too much influenced in general by the popular notion that the sea has been up and over the land time after time, and effected the scoopings and carvings of hill and valley,—the quiet and slow action of air and rain (universal, indeed, but lost sight of by the unobservant) having been neglected in many calculations as to the alterations the earth's surface has undergone. Now that advanced knowledge and improved observation have given credit to atmospheric agencies, rather than to marine action, for some of the enormous denudations recognized by geologists in past as well as in present times, we are not at all surprised to find some favouring the new views with such warmth as reaction, enthusiasm, and party-feeling usually create. With an earnest love of truth and of his subject, the writer of this pamphlet has carefully collated the statements of many geologists about "subaërial denudation," showing how much has already been done and thought on the subject; and he adds his own experience and views, somewhat dogmatically and with some contempt for those whom he regards as differing from him.

Scientific knowledge is arrived at by repeated efforts, with imperfect observation and half-true hypotheses; and every effort is regarded as good and true until further researches and better conclusions eliminate the errors, leaving a residuum of real truth as a basis for further advance. The "subaërialists" and the "submarinists" (we know not, indeed, if there be any pure and simple followers of these schools) may, by their one-sided efforts, help to carry on observation and knowledge; and it seems as unavoidable that this should be the natural method of progress in geology as that by tacking and tacking the wind-stayed ship should make its weary way to port. We look, then, on Mr. Whitaker's pamphlet, comprising his *résumé* of what has been done and his opinions of what ought to be thought, as an effort in the right direction; and we trust that, whether the ship's prow be now too much to windward or the contrary, the voyage is successfully, though laboriously, progressing towards the happy land of geologists, where all the strata will be seen and all the fossils deciphered, where homotaxis and boulder-drift are unknown, where ice will do everything to please some, and water slave for others, where the volcano will give up the secrets of its laboratory to solve the problems of the plutonist, and the hydrothermalist, no longer in hot water, will have his doubts removed.

PROCEEDINGS OF LEARNED SOCIETIES.

ROYAL SOCIETY.

April 23, 1868.—Dr. William Allen Miller, Treasurer and Vice-President, in the Chair.

"On the Geographical and Geological Relations of the Fauna and Flora of Palestine." By the Rev. Henry Baker Tristram, M.A., F.G.S.

A detailed examination of the fauna and flora exhibits results remarkably in accordance with the views expressed by Mr. Sclater and Dr. Günther on the geographical distribution of species. Palestine forms an extreme southern province of the Palæarctic region.

In every class, however, there are a group of peculiar forms, which cannot be explained simply by the fact of Palestine impinging closely on the Ethiopian, and more distantly on the Indian region, but which require a reference to the geological history of the country.

The results of the examination of the collections made in 1864 by the expedition assisted by the Royal Society, may be tabulated thus:—

	Total.	Palæarctic.	Ethiopian.	Indian, including those which are also Ethiopian.	Peculiar.
Mammalia	82	41	30*	13	7
Aves	326	258	36†	14	27
Reptilia	48	25	13‡	2	4§
Pisces, fluviatile	17	1	3	3	10‖
Mollusca.....	146	48	8	2	81
Flora, general..	963¶				
Flora, Dead-Sea basin (Phanerogamic)....	113	27	71**	26	3

Several of the Ethiopian Mammalia are sedentary forms, and seem to point to an earlier settlement than across the recent deserts. There is no trace of any immigration from the Indian region. Of the peculiar species, *Hyrax syriacus* belongs to an *exclusively* Ethiopian and isolated type, yet is specifically different from its congeners, which are all most sedentary in their habits.

The Avifauna is very rich in number of species, most unequally distributed. The Ethiopian and Indian types are almost exclusively confined to the Dead-Sea basin, excepting only the desert forms. There are several Indian species, as *Ketupa ceylonensis*, which have no affinities with any Ethiopian forms. Of the *peculiar* species, besides several modifications of well-known Palæarctic forms, there are eleven, belonging to as many different Ethiopian and Indian genera. Three of these are decidedly Indian in their affinities. The Avifauna of the Dead-Sea basin is decidedly distinct and typical, sometimes Indian, more generally Ethiopian in its character.

In the Reptilia there is a less prominent intrusion of Ethiopian types, there being a general similarity to the Egyptian herpetological fauna, which must be classed within the Palæarctic region. The Indian is present in *Daboia xanthina*; and the affinities of a new genus *Rhynchocalamus* are rather obscure. Snakes in particular are more limited to the original locality of the individuals; and the groups, like the individuals, are more stationary.

The fluviatile ichthyological fauna is much more distinct, though the number of species is small. In its consideration we confine ourselves to the Jordan and its tributaries, in which are three Nilotic fishes, three others extending eastward in Asia, six to other rivers of Syria, and four peculiar, bearing a strong affinity to the species and genera (as *Chromis* and *Hemichromis*) of tropical Eastern Africa.

Of the Mollusca, most of the peculiar species have no geographical signification. The Pulmonifera have developed in groups which

* Of which 9 are also Indian.
† Of which 8 are also Indian.
‡ Of which 1 is also Indian.
§ And 5 others Asiatic, but not Indian.
‖ Of which 5 are also Syrian and Asia Minor.
¶ About 1300 species are known from Palestine (Phanerogamic).
** Of which 26 are also Indian.

are modifications of desert types in the south, and of Mediterranean forms on the coast. Variation in this class appears rapidly to follow segregation, as shown by the Jordanic species. The fluviatile mollusca are much more distinct, and indicate a very ancient separation from any adjacent district.

Similar inferences may be drawn from the examination of the Arachnida, Lepidoptera, Hemiptera, and Orthoptera, as well as from the Rhizopod fauna, which is similar to that of the Indian Ocean. (The examination of the Coleoptera is not yet completed.)

The flora of Palestine is, on the coastline and highlands, simply a reproduction of that of the Eastern Mediterranean. That of the Jordan valley is *most* distinct. Of 113 species by the Dead Sea, only 27 are European, and these chiefly weeds of world-wide distribution. In this area the flora is almost exclusively Ethiopian, consisting largely of species extending from the Canaries to India.

Thus in the Dead-Sea basin, an area of but a few square miles, we find a series of forms of life, in all classes, differing from those of the surrounding region, to which they do not extend, and having Ethiopian and, more strictly, Indian affinities. The basin is depressed 1300 feet below the sea-level; and as zones of elevation correspond to parallels of latitude, so here a zone of depression represents the fauna and flora of a low latitude. If the flora were *representative*, this law, that climatal zones of life are mutually repeated and represented by elevation or depression and latitude, would account for their existence.

But we have a *transported* flora; this negatives the idea of an independent origin on the spot. The theory of migration, *under present conditions*, is refuted by the coexistence of peculiar and unique forms with others now found in regions widely apart. Of these, the physical character, and the phenomena of their present distribution, present insuperable obstacles to their migration under *existing* geological conditions.

Their existence must be mainly due to dispersion before the isolation of the area; this must have been after the close of the Eocene period, to which belong the most recent superficial deposits of Southern Palestine. There are no beds synchronizing with the miocene deposits of Sicily &c.; it must have had a fauna and flora contemporaneous with the miocene flora of Germany. There is geological evidence that since the Eocene period the Jordan fissure has had no connexion with the Red Sea or Mediterranean. There are *subsequent* vast marl deposits of the Dead Sea when it was at a higher level; but they are wholly unfossiliferous. The diminution of the waters may, for reasons given, be fixed about the close of the tertiary epoch. We have also evidence of the extension of the glacial period thus far south, as in the moraines of Lebanon.

Still the lake existed in its present form before the glacial epoch, when there was an unusually warmer climate, and the more antique Ethiopian fauna and flora had a more northerly extension. This would be contemporaneous with the miocene continent of Atlantis, and the Asturian flora of South-west Ireland.

Palestine would then be East African. Afterwards the glacial inroad would destroy the mass of preexisting life, excepting the few species most tenacious of existence, which survive in the still comparatively warm depression of the Jordan valley, which thus became a tropical "outlier," analogous to the boreal marine outliers of our own seas. The Indian types are explained by the former continuous miocene continent from India to Africa. The peculiar species may either yet be found in Arabia, or, if not, may be descendants of species which inhabited the country with a limited range, or may be variations stereotyped by isolation.

The peculiar fishes of the Jordan are most important, dating probably from the earliest period after the elevation of the land. The genera of the peculiar species are exclusively African, while the species are *representative* rather than identical. We may explain this by the miocene chain of freshwater lakes, extending from Galilee to the Nyanza, Nyassa, and Zambesi, when an ichthyological fauna was developed suited to the warm conditions that prevailed, part of which survives in the Jordan.

During the glacial period Lebanon must have been similar in temperature to the present Alps, as the existing mammals and birds on the summits are identical with those of the Pyrenees and the Alps; not so the glacial flora, of which almost every trace has been lost. But the flora had not the same powers of vertical migration with the fauna, of which, however, the Elk, Red Deer, and Reindeer, found in the bone-caverns, have long since perished.

During the present period the Mediterranean forms have overspread the whole country, excepting the mountain-tops at an elevation of 9000 feet and the Jordan depression. These two exceptions can be best explained by the fact that the traces of the glacial inroad are not yet wholly obliterated, and that the preceding warm period has left its yet stronger mark in the unique tropical "outlier" of the Dead-Sea basin, analogous to the boreal outliers of our mountain-tops, the concave depression in the one being the complement of the convex elevation in the other.

ROYAL INSTITUTION OF GREAT BRITAIN.

February 7, 1868.

"On the Animals which are most nearly intermediate between Birds and Reptiles." By Professor Huxley, LL.D., F.R.S.

Those who hold the doctrine of Evolution (and I am one of them) conceive that there are grounds for believing that the world, with all that is in it and on it, did not come into existence in the condition in which we now see it, nor in anything approaching that condition.

On the contrary, they hold that the present conformation and composition of the earth's crust, the distribution of land and water, and the infinitely diversified forms of animals and plants which constitute its present population, are merely the final terms in an immense series of changes which have been brought about, in the course of

immeasurable time, by the operation of causes more or less similar to those which are at work at the present day.

Perhaps this doctrine of evolution is not maintained consciously and in its logical integrity by a very great number of persons *. But many hold particular applications of it without committing themselves to the whole: and many, on the other hand, favour the general doctrine without giving an absolute assent to its particular applications.

Thus, one who adopts the nebular hypothesis in astronomy, or is a uniformitarian in geology, or a Darwinian in biology, is so far an adherent of the doctrine of evolution.

And, as I can testify from personal experience, it is possible to have a complete faith in the general doctrine of evolution and yet to hesitate in accepting the nebular, or the uniformitarian, or the Darwinian hypotheses in all their integrity and fulness: for many of the objections which are brought against these various hypotheses affect them only, and, even if they be valid, leave the general doctrine of evolution untouched.

On the other hand, it must be admitted that some arguments which are adduced against particular forms of the doctrine of evolution would very seriously affect the whole doctrine if they were proof against refutation.

For example, there is an objection which I see constantly and confidently urged against Mr. Darwin's views, but which really strikes at the heart of the whole doctrine of evolution, so far as it is applied to the organic world.

It is admitted on all sides that existing animals and plants are marked out by natural intervals into sundry very distinct groups: insects are widely different from fish, fish from reptiles, reptiles from mammals, and so on. And out of this fact arises the very pertinent objection, How is it, if all animals have proceeded by gradual modification from a common stock, that these great gaps exist?

We, who believe in evolution, reply that these gaps were once non-existent: that the connecting forms existed in previous epochs of the world's history, but that they have died out.

Naturally enough, then, we are asked to produce these extinct forms of life. Among the innumerable fossils of all ages which exist, we are asked to point to those which constitute such connecting forms.

Our reply to this request is, in most cases, an admission that such forms are not forthcoming; and we account for this failure of the needful evidence by the known imperfection of the geological record. We say that the series of formations with which we are acquainted is but a small fraction of those which have existed, and that between those which we know there are great breaks and gaps.

* The only complete and systematic statement of the doctrine with which I am acquainted is that contained in Mr. Herbert Spencer's 'System of Philosophy,' a work which should be carefully studied by all who desire to know whither scientific thought is tending.

I believe that these excuses have very great force ; but I cannot smother the uncomfortable feeling that they are excuses.

If a landed proprietor is asked to produce the title-deeds of his estate, and is obliged to reply that some of them were destroyed in a fire a century ago, that some were carried off by a dishonest attorney, and that the rest are in a safe somewhere, but that he really cannot lay his hands upon them, he cannot, I think, feel pleasantly secure, though all his allegations may be correct and his ownership indisputable. But a doctrine is a scientific estate, and the holder must always be able to produce his title-deeds, in the way of direct evidence, or take the penalty of that peculiar discomfort to which I have referred.

You will not be surprised, therefore, if I take this opportunity of pointing out that the objection to the doctrine of evolution, drawn from the supposed absence of intermediate forms in the fossil state, certainly does not hold good in all cases. In short, if I cannot produce the complete title-deeds of the doctrine of animal evolution, I am able to show a considerable piece of parchment evidently belonging to them.

To superficial observation no two groups of beings can appear to be more entirely dissimilar than reptiles and birds. Placed side by side, a Humming-bird and a Tortoise, an Ostrich and a Crocodile offer the strongest contrast, and a Stork seems to have little but animality in common with the Snake it swallows.

Careful investigation has shown, indeed, that these obvious differences are of a much more superficial character than might have been suspected, and that reptiles and birds do really agree much more closely than birds with mammals, or reptiles with amphibians. But still, "though not as wide as a church-door or as deep as a well," the gap between the two groups, in the present world, is considerable enough.

Without attempting to plunge you into the depths of anatomy, and confining myself to that osseous system to which those who desire to compare extinct with living animals are almost entirely restricted, I may mention the following as the most important differences between all the birds and reptiles which at present exist.

1. The pinion of a bird, which answers to the hand of a man or to the fore paw of a reptile, contains neither more nor fewer than three fingers. These answer to the thumb and the two succeeding fingers in man, and have their metacarpals connected together by firm bony union, or ankylosed. Claws are developed upon the ends of at most two of the three fingers (that answering to the thumb and the next), and are sometimes entirely absent.

No reptile with well-developed fore limbs has so few as three fingers; nor are the metacarpal bones of these ever united together; nor do they present fewer than three claws at their terminations.

2. The breast-bone of a bird becomes converted into a membrane bone, and ossification commences in it from at least two centres. The breast-bone of no reptile becomes converted into a membrane bone, nor does it ever ossify from several distinct centres.

3. A considerable number of caudal and lumbar, or dorsal, vertebræ unite together with the proper sacral vertebræ of a bird to form its "sacrum." In reptiles the same region of the spine is constituted by the one or two sacral vertebræ.

4. In Birds the haunch-bone (ilium) extends far in front of, as well as behind, the acetabulum; the ischia and pubes are directed backwards, almost parallel with it and with one another; the ischia do not unite in the ventral middle line of the body.

In reptiles, on the contrary, the haunch-bone is not produced in front of the acetabulum; and the axes of the ischia and pubes diverge and lie more or less at right angles to that of the illium. The ischia always unite in the middle ventral line of the body.

5. In all birds the axis of the thigh-bone lies nearly parallel with the median plane of the body (as in ordinary Mammalia) in the natural position of the leg. In reptiles it stands out at a more or less open angle with the median plane.

6. In birds, one half of the tarsus is inseparably united with the tibia, the other half with the metatarsal bone of the foot. This is not the case in reptiles.

7. Birds never have more than four toes, the fifth being always absent. The metatarsal of the hallux, or great toe, is always short and incomplete above. The other metatarsals are ankylosed together, and unite with one half of the tarsus, so as to form a single bone, which is called the tarso-metatarsus.

Reptiles with completely developed hind limbs have at fewest four toes, the metatarsals of which are all complete and distinct from one another.

Although all existing birds differ thus definitely from existing reptiles, one comparatively small section comes nearer reptiles than the others. These are the *Ratitæ*, or struthious birds, comprising the Ostrich, Rhea, Emu, Cassowary, Apteryx, and the but recently extinct (if they be really extinct) birds of New Zealand, *Dinornis* &c., which attained gigantic dimensions. All these birds are remarkable for the small size of their wings, the absence of a crest or keel upon the breast-bone, and of a complete furcula; in many cases, for the late union of the bones of the pinion, the foot, and the skull. In this last character, in the form of the sternum, of the shoulder-girdle, and in some peculiarities of the skull, these birds are more reptilian than the rest; but the total amount of approximation to the reptilian type is but small, and the gap between reptiles and birds is but very slightly narrowed by their existence.

How far can this gap be filled up by a reference to the records of the life of past ages?

This question resolves itself into two:—

1. Are any fossil birds more reptilian than any of those now living?

2. Are any fossil reptiles more bird-like than living reptiles?

And I shall endeavour to show that both these questions must be answered in the affirmative.

It is very instructive to note by how mere a chance it is we happen to know that a fossil bird, more reptilian in some respects than any now living, once existed.

Bones of birds have been obtained from rocks of very various dates in the Tertiary series without revealing any forms but such as would range themselves among existing families.

A few years ago the great Mesozoic formations had yielded only the few fragmentary ornitholites which have been discovered in the Cambridge greensand, and which are insufficient for the complete determination of the affinities of the bird to which they belonged.

However, the very fine calcareous mud of the ancient Oolitic sea-bottom which has now hardened into the famous lithographic slate of Solenhofen, and has preserved innumerable delicate organisms of the existence of which we should otherwise have been, in all probability, totally ignorant, in 1861 revealed the impression of a feather to the famous palæontologist Hermann von Meyer. Von Meyer named the unknown bird to which this feather belonged *Archæopteryx lithographica*; and in the same year the independent discovery by Dr. Häberlein of the precious skeleton of the *Archæopteryx* itself, which now adorns the British Museum *, demonstrated the chief characters of this very early bird. But it must be remembered that this feather and this imperfect skeleton are the sole remains of birds which have yet been obtained in all that great series of formations known as Wealden and Oolite, which partly lie above, and partly correspond with, the Solenhofen slates.

Though some palæontologists may be forced, by a sense of consistency, to declare that the class of birds was created in the sole person of *Archæopteryx* during the deposition of the Solenhofen slates and disappeared during the Wealden, to be recreated in the Greensand, to vanish once more during the Cretaceous epoch and reappear in the Tertiaries, I incline to the hypothesis that many birds beside *Archæopteryx* existed throughout all this period of time, and that we know nothing about them, simply because we do not happen to have hit upon those deposits in which their remains are preserved.

Now, what is this *Archæopteryx* like? Unfortunately the skull is lost; but the leg and foot, the pelvis, the shoulder-girdle, and the feathers, so far as their structure can be made out, are completely those of existing ordinary birds.

On the other hand, the tail is very long, and more like that of a reptile than that of a bird in this respect. Two digits of the manus have curved claws, much stronger than those of any existing bird; and, to all appearance, the metacarpal bones are quite free and disunited.

Thus it is a matter of fact that, in certain particulars, the oldest known bird does exhibit a closer approximation to reptilian structure than any modern bird.

Are any fossil reptiles more bird-like than those which now exist?

* The fossil has been described by Professor Owen, in the 'Philosophical Transactions' for 1863.

As in the case of birds, the tertiary formations yield no trace of reptiles which depart from the type of the existing groups. But otherwise than is true of birds, the newest of the Mesozoic formations, the chalk, makes us acquainted with reptiles which, at first sight, seem to approach birds in a very marked manner. These are those flying reptiles the Pterodactyles, which resemble the great majority of birds in the presence of air-cavities in their bones, in the wonderfully bird-like aspect of their coracoid and scapula, and in their broad sternum with its median crest. Furthermore, in some of the Pterodactyles, the præmaxillæ and the symphysial part of the mandibles were prolonged into beaks, which appear to have been sheathed in horn, while the rest of each jaw was armed with teeth.

But horn-sheathed beaks are found in reptiles as well as in birds; the structure of the scapulo-coracoid arch and of the sternum, and the pneumaticity of the bones vary greatly among birds themselves; and these characters of the Pterodactyles may be merely adaptive modifications.

On the other hand, the manus has four free digits, the three inner of which are strongly clawed, while the fourth is enormously prolonged, in total contrast to the abortion of the corresponding digit in birds. The pelvis is as wholly unlike that of birds as is the hind limb and foot.

Thus it appears that Pterodactyles, among reptiles, approach birds much as Bats, among mammals, may be said to do so. They are a sort of reptilian Bats * rather than links between reptiles and birds; and it is precisely in those organs which in birds are the most characteristically ornithic, the manus and the pes, that they depart most widely from the ornithic type.

Clearly, then, the passage from reptiles to birds is not from the flying reptile to the flying bird. Let us try another line. I have already observed that in the existing world the nearest approximation to reptiles is presented by certain land birds, the Ostriches and their allies, all of which are devoid of the power of flight by reason of the small relative size of their fore limbs and of the character of their feathers.

Can we find any extinct reptiles which approached these flightless birds, not merely in the weakness of their fore limbs, but in other and more important characters?

I imagine that we can, if we cast our eyes in what at first sight seems to be a most unlikely direction.

The *Dinosauria*, a group of extinct reptiles, containing the genera *Iguanodon*, *Hadrosaurus*, *Megalosaurus*, *Poikilopleuron*, *Scelidosaurus*, *Plateosaurus*, &c., which occur throughout the whole series of the Mesozoic rocks, and are, for the most part, of gigantic size, appear to me to furnish the required conditions.

In none of these animals is the skull or the cervical region of

* It will be understood that I do not suggest any direct affinity between Pterodactyles and Bats.

the vertebral column completely known, while the sternum and the manus have not yet been obtained in any of the genera. In none has any trace of a clavicle been observed.

With regard to the characters which have been positively determined, it has been ascertained that :—

1. From four to six vertebræ enter into the composition of the sacrum, and become connected with the ilia in a manner which is partly ornithic, partly reptilian.

2. The ilia are prolonged forwards in front of the acetabulum as well as behind it; and the resemblance to the bird's ilium thus produced is greatly increased by the widely arched form of the acetabular margin of the bone, and the extensive perforation of the floor of the acetabulum.

3. The other two components of the *os innominatum* have not been observed actually in place ; indeed only one of them is known at all ; but that one is exceedingly remarkable from its strongly ornithic character. It is the bone which has been called "clavicle" in *Megalosaurus* and *Iguanodon* by Cuvier and his successors, though the sagacious Buckland had hinted its real nature *. But these bones are not in the least like the clavicles of any animal which possesses a clavicle, while they are extremely similar to the ischia of such a bird as an ostrich ; and in the only instance in which they have been found in tolerably undisturbed relation with other parts of the skeleton, namely, in the Maidstone *Iguanodon*, they lie, one upon each side of the body, close to the ilia. I hold it to be certain that these bones belong to the pelvis, and not to the shoulder-girdle, and I think it probable that they are ischia; but I do not deny that they may be pubes.

4. The head of the femur is set on at right angles to the shaft of the bone, so that the axis of the thigh-bone must have been parallel with the middle vertical plane of the body, as in birds.

5. The posterior surface of the external condyle of the femur presents a strong crest, which passes between the head of the fibula and the tibia as in birds. There is only a rudiment of this structure in other reptiles.

6. The tibia has a great anterior or "procnemial" crest, convex on the inner and concave on the outer side. Nothing comparable to this exists in other reptiles; but a correspondingly developed crest exists in the great majority of birds, especially such as have great walking or swimming powers.

7. The lower extremity of the fibula is much smaller than the other ; it is, proportionally, a more slender bone than in other reptiles. In birds the distal end of the fibula thins away to a point, and it is a still more slender bone.

8. *Scelidosaurus* has four complete toes, but there is a rudiment of a fifth metatarsal. The third or middle toe is the largest, and the

* The so-called "coracoid" of *Megalosaurus* is the ilium. I am indebted to Professor Phillips, and to the splendid collection of Megalosaurian remains which he has formed at Oxford, for most important evidence touching this reptile.

metatarsal of the hallux is much smaller at its proximal than at its distal end.

Iguanodon has three large toes, of which the middle is the longest. The slender proximal end of a first metatarsal has been found adherent to the inner face of the second; so that if the hallux was completely developed, it was probably very small. No rudiment of the outer toe has been observed.

It is clear, from the manner in which the three principal metatarsals articulate together, that they were very intimately and firmly united, and that a sufficient base for the support of the body was afforded by the spreading out of the phalangeal regions of the toes.

From the great difference in size between the fore and hind limbs, Mantell, and more recently Leidy, have concluded that the *Dinosauria* (at least *Iguanodon* and *Hadrosaurus*) may have supported themselves for a longer or shorter period upon their hind legs. But the discovery made in the weald, by Mr. Beckles, of pairs of large three-toed footprints, of such a size and at such a distance apart that it is difficult to believe they can have been made by anything but an *Iguanodon*, lead to the supposition that this vast reptile, and perhaps others of its family, must have walked, temporarily or permanently, upon its hind legs.

However this may be, there can be no doubt that the hind quarters of the *Dinosauria* wonderfully approached those of birds in their general structure, and therefore that these extinct reptiles were more closely allied to birds than any which now live.

But a single specimen, obtained from those Solenhofen slates to the accident of whose existence and usefulness in the arts palæontology is so much indebted, affords a still nearer approximation to the "missing link" between reptiles and birds. This is the singular reptile which has been described and named *Compsognathus longipes* by the late Andreas Wagner, and some of the more recondite ornithic affinities of which have been since pointed out by Gegenbaur. Notwithstanding its small size (it was not much more than 2 feet in length), this reptile must, I think, be placed among, or close to, the *Dinosauria*; but it is still more bird-like than any of the animals which are ordinarily included in that group.

Compsognathus longipes has a light head, with toothed jaws, supported upon a very long and slender neck. The ilia are prolonged in front of and behind the acetabulum. The pubes seem to have been remarkably long and slender (a circumstance which rather favours the interpretation of the so-called "clavicles" of *Iguanodon* as pubes). The fore limb is very small. The bones of the manus are unfortunately shattered; but only four claws are to be found, so that possibly each manus may have had but two clawed digits.

The hind limb is very large, and disposed as in birds. As in the latter class, the femur is shorter than the tibia—a circumstance in which *Compsognathus* is more ornithic than the ordinary *Dinosauria*.

The proximal division of the tarsus is ankylosed with the tibia, as in birds. In the foot the distal tarsals are not united with the three

long and slender metatarsals, which answer to the second, third, and fourth toes. Of the fifth toe there is only a rudimentary metatarsal. The hallux is short, and its metatarsal appears to be deficient at its proximal end.

It is impossible to look at the conformation of this strange reptile and to doubt that it hopped or walked, in an erect or semierect position, after the manner of a bird, to which its long neck, slight head, and small anterior limbs must have given it an extraordinary resemblance.

I have now, I hope, redeemed my promise to show that, in past times, birds more like reptiles than any now living, and reptiles more like birds than any now living, did really exist.

But, on the mere doctrine of chances, it would be the height of improbability that the couple of skeletons, each unique of its kind, which have been preserved in those comparatively small beds of Solenhofen slate, which record the life of a fraction of Mesozoic time, should be the relics, the one of the most reptilian of birds, and the other of the most ornithic of reptiles.

And this conclusion acquires a far greater force when we reflect upon that wonderful evidence of the life of the Triassic age which is afforded us by the sandstones of Connecticut. It is true that these have yielded neither feathers nor bones; but the creatures which traversed them when they were the sandy beaches of a quiet sea have left innumerable tracks which are full of instructive suggestion. Many of these tracks are wholly undistinguishable from those of modern birds in form and size; others are gigantic three-toed impressions, like those of the Weald of our own country; others are more like the marks left by existing reptiles or Amphibia.

The important truth which these tracks reveal is, that at the commencement of the Mesozoic epoch bipedal animals existed which had the feet of birds, and walked in the same erect or semierect fashion. These bipeds were either birds or reptiles, or more probably both; and it can hardly be doubted that a lithographic slate of Triassic age would yield birds so much more reptilian than *Archæopteryx*, and reptiles so much more ornithic than *Compsognathus*, as to obliterate completely the gap which they still leave between reptiles and birds.

But if, on tracing the forms of animal life back in time, we meet, as a matter of fact, with reptiles which depart from the general type to become bird-like, until it is by no means difficult to imagine a creature completely intermediate between *Dromæus* and *Compsognathus*, surely there is nothing very wild or illegitimate in the hypothesis that the *phylum* of the class Aves has its root in the Dinosaurian reptiles—that these, passing through a series of such modifications as are exhibited in one of their phases by *Compsognathus*, have given rise to the *Ratitæ*—while the *Carinatæ* are still further modifications and differentiations of these last, attaining their highest specialization in the existing world in the Penguins, the Cormorants, the birds of prey, the Parrots, and the song-birds.

However, as many completely differentiated birds in all probability existed even in the Triassic epoch, and as we possess hardly any knowledge of the terrestrial reptiles of that period, it may be regarded as certain that we have no knowledge of the animals which linked reptiles and birds together historically and genetically, and that the *Dinosauria*, with *Compsognathus*, *Archæopteryx*, and the struthious birds, only help us to form a reasonable conception of what these intermediate forms may have been.

In conclusion, I think I have shown cause for the assertion that the facts of palæontology, so far as birds and reptiles are concerned, are not opposed to the doctrine of evolution, but, on the contrary, are quite such as that doctrine would lead us to expect; for they enable us to form a conception of the manner in which birds may have been evolved from reptiles, and thereby justify us in maintaining the superiority of the hypothesis that birds have been so originated to all hypotheses which are devoid of an equivalent basis of fact.

MISCELLANEOUS.

Occurrence of Tinnunculus cenchris *in Britain.*

By W. S. Dallas, F.L.S.

This Museum has just been fortunate enough to obtain a fine specimen, killed within a few miles of York, of a species of Falcon, the occurrence of which in this country has, I believe, never before been authentically recorded,—namely, the little Kestrel of South-eastern Europe, *Tinnunculus cenchris* (Naum.). The specimen, which is a mature but apparently not an old male, was presented to the Museum by Mr. John Harrison, of Wilstrop Hall, near Green Hammerton, who shot it upon his farm at that place, after having observed it for some little time flying about. The date, he thinks, was about the middle of last November; but of this he took no note, as he at first thought that the bird was merely a small and curious variety of the common Kestrel. It, however, presents all the distinctive characters of *Tinnunculus cenchris*, among which the yellowish-white claws may be mentioned as affording an easy means of identifying the bird.

Mr. Graham, of York, to whose intervention the Museum is indebted for the acquisition of this interesting specimen, has informed me that, on a recent excursion of his, he saw another example of this species, in the possession of the Rev. Charles Hudson, of Trowell, near Nottingham. On my writing to that gentleman, he kindly informed me that the specimen of the "small Kestrel" had been in his possession for about eight years, and that he purchased it from a joiner named Brown, formerly living at Thorpe Hall, near Bridlington, who was an enthusiastic collector of birds, and in the habit of preparing them for people in that neighbourhood. Brown's account of the bird, which he denominated the "American Falcon,"

was that it was shot between Bridlington and Bridlington Quay, one Sunday morning, by a man who sold it to him for eighteen pence. Mr. Hudson purchased it for half a sovereign.

Museum, York, June 24, 1868.

Lithodomous Annelids.

To the Editors of the Annals and Magazine of Natural History.

Gentlemen,—As I am anxious to put on record all the cases which I can ascertain of the occurrence of Lithodomous Annelids or worms, allow me to mention that I find that Dr. Ed. Grube, in his "Beschreibungen neuer oder wenig bekannter Anneliden," published in the 'Archiv für Naturgesch.' vol. xxi. 1855, has described, under the name of *Heterocirrus saxicola*, an Annelid which perforates limestone, and belongs to the same family (though differing in important generic features) as *Leucodore*, Johnston (*Polydora*, Bosc). The Annelid was found at Villa Franca.

I also find that that most accurate and talented investigator, M. Lacaze-Duthiers, in his researches on the Gephyrean *Bonellia*, observed that this animal inhabited cracks in rocks, and by preference *calcareous* rocks; further, he noted, in the case of *calcareous* rocks, that the rock was to a certain extent excavated, thus fitting to the body of the worm. It is almost impossible to assign any but a chemical means of excavation to *Bonellia*.

I am, Gentlemen,
Truly yours,
E. Ray Lankester.

Oxford, June 4th.

On some Species of Oliva.

To the Editors of the Annals and Magazine of Natural History.

Gentlemen,—I have but just now seen Mr. Marrat's reply to my observations on this subject. In considering the value of the species in question, I weighed the matter as far as it was possible to do it without seeing the specimens. Whether my conclusions are wrong or not, it is not for me to say.

As regards the apparent inaccuracies in my paper pointed out by Mr. Marrat, he will, I think, find, on referring to it again, that they are explained by the context.

With respect to my observation as to the fallibility of colour as a guide for distinguishing species, I cannot help thinking that Mr. Marrat's reply tends rather to prove its truth than otherwise.

As far as I am concerned, the question as to the specific value of Mr. Marrat's species will rest here.

I am, Gentlemen, yours, &c.
Thomas Graham Ponton.

Clifton, Bristol, June 26, 1868.

Note on a Variety (?) *of* Alcyonella fungosa.

To the Editors of the Annals and Magazine of Natural History.

Gentlemen,—I have much pleasure in introducing to your notice a variety, as I believe it to be, of the above species; it grows in large pyriform or fusiform masses, on twigs of bushes dipping just below the surface of the water, in a pond about a mile from Exeter, near the South-western Railway.

The polyzoon has from forty-eight to fifty tentacles, which are much longer than those figured by Professor Allman. The cœnœcium is repeatedly branched from the base upwards: the upper branches only are free; the lower portion is of a very tough, dark-brown, nearly black, coriaceous substance, the upper or free portion thin and transparent; and, instead of being smooth, these are wrinkled into a number of transverse folds, the edges of which are frequently coloured brown. Some of the apices of the ectocyst are nearly smooth, or with only the rudiments of folds; and others, again, are rugged, and the orifices widened and rolled back, so as to give them a sort of trumpet-shaped mouth; but they all have the brown annulations as above mentioned.

The apices of the ectocyst are emarginate or notched similarly to those of *A. Benedeni*, but they have no appearance whatever of a ridge or furrow.

The statoblasts are of three kinds:—1. Those with a rather broad annulus, and the centre perforated with a rather large perforation, the sides or edges of which are pressed into slight plaits or folds; these vary in colour from pale yellowish brown to a full rich brown; they are dotted with raised points, the same as in the type figured by Professor Allman; the annulus is reticulated the same. 2. With a much broader outline, nearly orbicular, dark brown, and without any perforation. 3. Forming a very broad ellipse, and with a comparatively very broad annulus; this forms somewhat of an angle, or point, at the long axis of the ellipse, nearly approaching the form of the statoblast in *Lophopus crystallinus*; but they are thicker and more opaque than in that species.

The above appear to be the principal differences that I have been able to observe in this variety or species. There is one more, however, which may have some weight; and that is the form of the tubes: these are not round as in *A. Benedeni*, or pentangular as in *A. fungosa*, but are intermediate between the two; for when a section is made of a mass of tubes at right angles to their length, they will be seen to be irregular, the outside ones round, whilst those on the inside are from 3- to 4-, 5-, or 6-angular.

This variety appears to me to be intermediate between *A. fungosa* proper and *A. Benedeni*, as it seems to possess characters belonging to both. Thus the round tubes and the emarginate mouth would point to *Benedeni*; whilst the subangular tubes and the mode of growth and attachment, with the form of the staloblasts, point to *fungosa*, leaving the remarkable rugose and annulose appearance of the cœnœcium peculiar to this variety.

The pond in which this was found is a very small one, only 5 or 6 yards in diameter, and the only other species I have met with in it is *Lophopus crystallinus*; of the latter I have not met with any this year. This variety grows attached to twigs in the full blaze of the sun; and the little animals appear to enjoy it immensely. The specimen I obtained was about four inches long, by an inch thick in the middle; but I left another about the same length but apparently thicker.

I am, Gentlemen,
Yours obediently,
EDWARD PARFITT.

Devon and Exeter Institution,
Exeter, June 18, 1868.

On the Avicolar Sarcoptidæ, and on the Metamorphoses of the Acarina.
By C. ROBIN.

The Acarina pass through a series of metamorphoses—a hexapod larva issuing from the egg becoming converted into a nympha, from which the adult Mite proceeds. The author has observed in the Sarcoptidæ a more complicated series of phenomena; in these the males pass through four, and the females through five stages, indicated as follows:—

1. The *egg*, on issuing from which the animal has the form of
2. A *hexapod larva*, followed by the stage of
3. *Octopod nymphæ* without sexual organs.
4. From some of these nymphæ issue:—*a*, *sexual males*, after a moult which is final for them; *b*, from others issue *females without external sexual organs*, resembling the nymphæ, but larger, and in some species furnished with special copulatory organs.

Finally, after a last moult following copulation, these females produce

5. *The sexual and fecundated females*, which do not copulate, and in the ovary of which eggs are to be seen. No moult follows that which produces males or females furnished with sexual organs; but previously to this the moults are more numerous than the changes of condition.

Ovular and embryonal state.—The eggs of these Acarina are of a cylindroid form with rounded ends, one of which is smaller than the other, and corresponds with the rostrum. They are more or less flattened on one side; and to this surface the ventral surface of the young animal corresponds. The exclusion is effected by the division of the cephalic extremity into two halves. The ova are deposited by the avicolar Sarcoptidæ in the angle formed by the barbs with the stem of the feather. In general the segmentation of the vitellus has not commenced when the eggs are laid; but in some species the vitellus is divided into four lobes while the egg is still in the oviduct. The division takes place in planes perpendicular to the greater axis of the vitellus.

The Larva.—In all the species the larvæ are hexapod; and the arrangement of the epimera shows that it is the third, and not the

fourth pair that they possess on issuing from the egg. When the males have the fourth pair of legs disproportionately large, these legs remain small throughout the preparatory state, and only acquire their large size under the skin of the nympha before the last moult. The larvæ undergo from two to three moults before passing to the state of nymphæ. They have only one pair of hairs at the apex of the abdomen.

The Nymphæ.—The impuberal octopod individuals, or nymphæ, show no distinctive sexual characters. In those species the males of which have the fourth pair of legs disproportionately large, these remain small during the whole of this state, and increase in size under the skin before the last moult, at the same time that the sexual organs are produced. At the same period are formed the posterior prolongations of the abdomen in some species; and at its close the sex of the individuals may be distinguished.

In the larva from which a nympha is to be produced, the fourth pair of feet are seen beneath the skin, folded forwards. These and the lobes and hairs borne by many nymphæ are evidently produced beneath the skin of the larva. The nymphæ have two pairs of long setæ at the apex of the abdomen.

The nymphæ have only the single *granular tegumentary plate of the epistoma*, the *thoraco-abdominal plate* of the sexual individuals being wanting in them. They undergo two or three moults in this state.

The coupled females.—These, although larger, are not always easy to distinguish from the nymphæ; in some species they have two colourless appendages to the hinder part of the body, which do not exist in the nymphæ. This copulation of adult males with individuals having no sexual organs is remarkable, as nothing of the kind has been observed in *Tyroglyphus*, *Glyciphagus*, &c., although a similar phenomenon was noticed in *Psoroptes* by Bourguignon and Delafond. In these avicolar Sarcoptidæ a female may often be seen in copulation and retained by the male, showing through her integuments a female with well-developed genital organs. The adhesion of the male to the female is effected by means of the two anal disks possessed by the former. The adhesion lasts for some days, but the actual coition seems to occupy but a small portion of this time. The ova are developed in the ovaries of the females whilst still in this nymph-like form, and before the final moult.

The author remarks upon the relationships of these parasitic Sarcoptidæ, and gives the following list, in a note, of the forms observed by him, which will be fully described in his memoir:—1. *Pterolichus*, g. n., including 5 new species; 2. *Dermalichus* (Koch), sp. *passerinus* (Linn.), *oscinum* (Koch), and 1 new species; 3. *Pteronyssus*, g. n., sp. *Dermal. picinus* (Koch); 4. *Proctophyllodes*, g. n., sp. *Dermal. glandarinus* (Koch), and 4 new species; 5. *Pterodectes*, g. n., with 3 new species.—*Comptes Rendus*, tome lxvi. April 20, 1868, pp. 776–786.

The Pelvis and Hind Limbs of Whales.

Professor Van Beneden has read a paper at the Academy of

Sciences of Brussels describing the pelvis of Cetacea. He has described and figured the femur and tibia of the Greenland Whale; they are both rudimentary, and somewhat similar to the rudimentary femur observed by Mr. Flower when describing the Finner Whale (*Physalus*).

On a remarkable Form of Pleuronectidæ *from the Mediterranean.* By Dr. Steindachner.

This fish, described under the name of *Apionichthys Ottonis*, has rudimentary, punctiform eyes, a short, fissure-like branchial aperture, and a long pointed caudal fin, into which the dorsal and anal gradually pass. The length of the head is contained $5\frac{1}{2}$ times, the depth of the body $3\frac{1}{2}$ times, and the caudal $4\frac{1}{6}$ times in the total length. On the blind side of the body the ventral is wanting. The lateral line passes through 87–90 scales; the dorsal contains 70–73 and the anal 52–54 rays. On the upper margin of the lower lip there are 16–17 cilia, but only on the eye-bearing side of the head. The nasal orifice on the blind side of the head is dilated into a disk, and lobed.—*Anzeige der Akad. der Wiss. in Wien*, May 22, 1868, p. 120.

On the Antherozoids of the Mosses. By E. Roze.

The author's first investigations on the antherozoids of the Mosses led him to express the opinion that these organs are composed of a biciliated filament with two spiral turns, to which a mass of amylaceous granules adhered, but only during their motility. In the spring of this year he ascertained that these granules, instead of being affixed directly to the spiral, are contained in a hyaline plasmic vesicle, which is attached to the filament by a sort of tangential adhesion.

Under a power of 1500 diameters, this vesicle is clearly discerned, both by its spheroidal outline and by the very brisk molecular movements of its contents. It swells in water immediately after the quiescence of the ciliated spiral; then it suddenly bursts, and the amylaceous granules continue in the liquid the lively molecular trepidation which seems normally, in the vesicle, to coincide with the cessation of the ciliary movement.

Except as regards the existence of this vesicle, the facts previously indicated by the author are by no means modified. From this new fact it appears that the antherozoids of all classes of Cryptogamia present not only an organ of locomotion, but also a vesicular appendage filled with a plasmic liquid suspending either non-analyzable grains or amylaceous granules. This fact was foreseen by M. A. Brongniart. The author's recent observations were made upon the antherozoids of various genera of Polytrichaceæ (*Atrichum*, *Pogonatum*, *Polytrichum*), still contained in their mother cells, and upon the free antherozoids of *Bryum capillare* and *pseudotriquetrum*, *Mnium hornum*, and *Hypnum cupressiforme*.—*Comptes Rendus*, tome lxvi. June 15, 1868, pp. 1222–1223.

THE ANNALS

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[FOURTH SERIES.]

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VIII.—*On a remarkable Sponge from the North Sea.*

By S. Lovén*.

[Plate VI.]

The Swedish Museum of Natural History at Stockholm possesses two specimens of a siliceous sponge which seem to well deserve a careful examination. One of them belongs to collections made by myself long ago on the coasts of Finmark, while the other was obtained last year by M. G. von Yhlen in the North Sea, on the Storeggen, at the depth of about two hundred fathoms, and presented by him to the Museum. Both are preserved in spirits.

The external form of this sponge is peculiar—a clavate body, which may be called the head, supported by a slender stem thrice as long, round, and somewhat curved, the inferior end of which has been attached to the bottom of the sea by numerous roots (Pl. VI. fig. 1). The whole sponge without the roots is 52 millimetres high, the length of the head 13 millims., that of the stem 39 millims. The colour is pale yellowish grey. The transverse section of the head is oval; its upper surface is flattened, and in one specimen quite plain; in the other (fig. 2) it has a large, oblong, well-defined aperture, from which canals, separated by irregular partitions, are seen to penetrate into the interior. This is the well-known osculum (Bowerbank), which the living Sponge is capable of opening and closing at will, and its interior canal-system. The surface of the head (fig. 3) is smooth, finely and irregularly reticulated, with scattered and somewhat larger lacunæ, and, when seen under the microscope, seems as if covered with very fine hairs from projecting spicules. The stem, which is hard, firm, and elastic, has a distinct, finely hairy

* Translated from the 'Öfversigt af K. Vetenskaps Akademiens Förhandlingar,' Stockholm, 1868, p. 105.

dermal layer. Its inferior end is thickened into a dilated base, from which the fine root-fibres spread in branches, forming loops, and having attached to them numerous grains of sand, spicules of sponges, and Foraminifera.

A closer examination has given the following results. The dermal layer of the stem is thin, but tough, and may be drawn off in long pieces. It then shows a transparent uncoloured protoplasma, full of small yellowish granular corpuscles, with or without larger granules (fig. 4). In this parenchyma is imbedded (fig. 5) a felt of very small siliceous spicules, spindle-shaped, not inflated in the middle, furnished with a central canal (fig. 6). When measured, these were found to be from 0·1 millim. in length and 0·0018 millim. in thickness to 0·08 millim. in length and 0·002 millim. in thickness; the mean length was 0·08 millim., and the relation between length and thickness in one as 100 : 3·6, in another as 100 : 1·8, the mean of eight measurements as 100 : 2·76. The granules of the parenchyma are more discernible if prepared with glycerine, while the spicules are more distinct in Canada balsam.

Within the dermal layer the stem is made up of closely packed spicules, held together by a relatively small quantity of parenchyma (fig. 7). At first sight it seems as if the stem were composed of very long, rather spiral filaments; but a closer examination shows the spicules to be very short, but disposed in strings; so that the whole has the aspect presented in fig. 8. The spicules are all of the same type: they are spindle-shaped needles (figs. 9, 10, 11), having near the middle a slight but distinct globular inflation or nodule, and tapering towards either end from that point, not in a straight line, but forming together a very obtuse angle. It is owing to this peculiarity that the needles, united in rows, produce the slightly spiral structure of the stem. Every needle ends in a fine but rounded point (fig. 12). They are more or less round. The layers of which they consist are not to be discerned; only the exterior one appears in the transverse section (fig. 13) as a very thin ring. They have a fine central canal, which, if the needle is not broken, is closed at the point. When the inflation in the middle is not larger than is shown in figs. 9, 10, 11, the central canal goes through it without branching; but if the nodule has increased a little more in two opposite directions (as is shown in fig. 14), which is very seldom the case, two fine but distinct transverse canals are seen to go off crosswise from the central canal into its nodule or inflation. I have not observed this formation of secondary canals in the middle nodule carried further than shown in fig. 14; it is an incipient branching, and appears also in other parts of the

needle. Figs. 15 and 16 show beginnings of such branches directed towards the middle of the needle; figs. 17 and 18 the same directed towards the point. Sometimes the branching is double crosswise, four branches with four canals (fig. 19), sometimes regularly, sometimes rather irregularly, or in connexion with bifurcation (fig. 20). I have, besides, several times found an irregular heap of round, bladder-like tuberosities (figs. 21, 22, 23), to which the central canal gives no branches. Often there are spicules with graduated points (figs. 24, 25); very seldom their surface is studded with short, pointed projections (fig. 26).

When the spicule is perfectly entire and uninjured, the contents of the central canal, even after boiling in nitric acid, retain their transparency; but if the spicule has been broken, even scarcely perceptibly, at the outermost point, the canal is partly filled with long, interrupted columns of gas, less transparent than the lumen of the canal (figs. 28, 29, 30).

Prof. Lieberkühn observed the first formation of siliceous spicules in young individuals of *Spongilla**. In a cell with nucleus and nucleolus there appears among the granules a little ball of silica, from which, in opposite directions, but not exactly in the same straight line, shoot out two points, which are little by little elongated, until they form spindle-shaped needles, the ball remaining near the middle as the nodule. It is hardly to be doubted that the inflation or nodule in the spindle-shaped needles of our sponge, and which, as long as it is of small size, receives no branches from the central canal, is the part earliest formed—the siliceous ball. Of the growth of the needle, free in the parenchyma, we know at present very little. It increases by layers one over another. Prof. Kölliker, who regards the canal as a solid fibre of soft organic matter, on which, within the cell and from its contents, silica is deposited, supposes that the spicule increases by secretion of silica from the parenchyma in layers one above another†. In our sponge these layers are scarcely discernible. But another siliceous sponge from the Arctic Sea has offered some observations which may deserve to be previously mentioned here. The layers are very distinct, and seem to be alternately soft and hard. A spicule has lost, near the end, its exterior layer, so that the point projects beyond the remaining part of it, as out of a sheath. Between the outermost broken lamella and the exterior surface of the uninjured point there is a space, the former contents of which, a soft substance, have disappeared, the Canada balsam now occupying their place. If one of the

* Müller's Archiv, 1856, p. 408, t. 15. f. 17–23.

† Icones histiologicæ, i. p. 61.

spicules, boiled in nitric acid, has been a little damaged, its inner parts are altered; if the point is broken, there appears in the canal, and between two or more layers of silica, besides some gas, a black substance—the carbonized soft matter. If the point is not damaged, but the side, this substance is spread between the outermost layer and the next, but the canal and the inner layers retain their transparency unaltered. In one spicule a part of the canal and the interval between the innermost and the following layer is filled with the dark substance, which has been pressed out right through a third layer, by very fine pores, at right angles from the longitudinal axis. From this it seems to follow that the canal, normally closed at the ends, contains a soft organic matter alternating with the lamellæ of silica in such a manner that one of these is the exterior, and that the layers are perforated with minute pores. The fluid contents of the needle accordingly may be in contact with the exterior, and an exchange of substance take place. That this is really the case is shown by the manner in which branches are first formed, when the hitherto firm and straight lamellæ, as if yielding to a force from the interior, without fracture, bend outwards with undiminished thickness, and, bulging out, soon take up in the interior a branch from the central canal. The silica of the exterior layers has its source in the surrounding parenchyma. The spicule is by degrees covered with new layers of silica. If an anchorate spicule, which is of the same structure, with central canal and lamellæ, is brought into contact with a needle, it is soldered to it, covered with layers of silica, and finally partly immersed in the needle, thick and with blunted outlines, whilst in the interior the originally slender and elaborate form is well discerned through the glassy mass.

The spicules of our sponge are of various lengths. I have found them from 2·93 millims. in length and 0·047 millim. in thickness to 0·79 millim. in length and 0·01 millim. in thickness, the mean length 2·12 millims.,—the relation of length to thickness being in one as 100 : 1·95, in another as 100 : 0·93, the mean relation as 100 : 1·42.

The stem is continued into the head above its middle, and there ends conically. From that part proceed the spicules which give to the head its structure, form, and consistency (figs. 31, 32). Between the erect spicules of the stem, bundles of needles are inserted (fig. 33), which radiate in different directions (if with any regularity I cannot say), downwards, upwards, and to the sides. These bundles are light and firm as the stem, arcuated, gradually broader and somewhat flattened, soon divided into several almost cylindrical branches;

they consist of spindle-shaped needles, of exactly the same type as those of the stem, but smaller. Ten measurements have given from 1·14 millim. in length and 0·013 millim. in thickness to 0·4 millim. in length and 0·011 millim. in thickness; the mean length was 0·73 millim., and the relation of length to thickness in one as 100 : 2·86, in another as 100 : 1·09, the mean of twelve measurements being 100 : 1·85. Very rarely there appear some few small straight needles without nodules near the middle (fig. 27). The nearer the surface, the more the bundles divide; but, regularly, not one of their spicules reaches out of the dermal layer, in which appear other spicules (fig. 34) of the same type as those in the skin of the stem, but longer, arcuated, without nodule (fig. 35), and placed in the same manner. The measurements gave from 0·45 millim. in length and 0·004 millim. in thickness to 0·34 millim. in length and 0·0046 millim. in thickness; the mean length was 0·39 millim.; the relation of length to thickness in one as 100 : 1·25, in another as 100 : 0·8, the mean being 100 : 1.

The interstices between these bundles of spicules, which form the partitions of the canal-system of the head, are filled with the parenchyma, which, although it has been a very long time under the influence of the alcohol, has a yellowish-brown colour, is firm and tough, has very numerous, mostly oblong corpuscles and granules, among which there are some larger ones with granular contents (fig. 36).

From the rather thickened base of the stem, out of its dermal layer, a great number of roots go off, irregular and branched filaments here and there forming loops and gradually spreading over a surface almost twice as great as the upper surface of the head (fig. 37). The roots consist in greater part of a tolerably transparent colourless substance, the same as that of the skin, covered by a somewhat thin layer of fine, yellowish, granular matter. Very rare, extremely small and straight spicules may possibly belong to this layer, though it is very difficult to refer them to it with certainty among the great number of foreign objects of many kinds which are attached by the granular layer's having crept over them and penetrated even into the canal of the fragments of sponge-spicules (fig. 38).

When the stem of the sponge is broken not far from the root, and the upper part, thus separated from the basal, is turned upside down and placed on the flattened surface of the head, the stump of the stem directed upwards, it has an unquestionable likeness to the well-known *Hyalonema Sieboldi*, Gray, as this has been hitherto exhibited. What we have

called the head answers to "the sponge" of the *Hyalonema*, and the stump of the stem to the splendid "twisted cord" hitherto supposed to rise from the sponge. But the difference of size is very considerable. The large specimen of *Hyalonema* figured by Professor Max Schultze has "the sponge" ten times as high and in volume more than six hundred times as large as the head of our sponge, "the twisted cord" eight times as long and very much thicker.

The opinions as to the true nature of the *Hyalonema* have been widely different among naturalists. That the zoophyte *Palythoa* and the sponge *Hyalonema* are two separate organisms no doubt is possible. Professor Max Schultze's researches have settled this question, on which opinions have been so divided. In another point all who have treated of the *Hyalonema* as a natural production have agreed: they all assume "the sponge" to be the basal part, "the coil" a part arising from it.

But if we regard the *Hyalonema* in the contrary manner, if we place it so that "the sponge" is upwards, "the coil" downwards, and suppose this to be only a part of the stem, torn off by the fisherman's line, the remainder having been left attached to the bottom (in the same manner, for example, as the deeply immersed *Lygus mirabilis* (O. F. M.) is so often cut off by the dredge), and if we then compare it more closely with the sponge here described and figured, we shall have, as I will try to show, a view of its structure and habits approaching more nearly to the truth than that now generally accepted.

The surface of the *Hyalonema* called the lower one of "the sponge" is now the upper one, corresponding to that which is marked *a* in fig. 1, and shown by fig. 2. In our sponge this surface is provided with a great osculum, in the bottom of which the canal-system is seen entering the inner parts of the head. Professor Max Schultze is the only author who has described the same surface in the *Hyalonema*. If ever attached to the bottom, it ought to bear traces of it; sand, fragments of shells, Foraminifera would, as usual (for example, in *Euplectella cucumer*, Owen, and *E. aspergillum*, Owen), adhere to it. This, however, is not mentioned. On the other hand, there open on this surface "not less than six irregularly oval apertures, half an inch wide, which are in connexion with anastomosing canals, bordered by a membranous and porous network of siliceous needles. These canals can be followed as far as two inches deep in the sponge, and form an irregular lacunar system, which is in conjunction, through the fine meshes of the spongious network, with the openings on the surface." It is evidently the oscula of *Hyalonema*, with the

canal-system, which Prof. Schultze here describes; and it is difficult to explain the extraordinary circumstance that these openings, which are so important to the life of the sponge, should have their place where it is adherent to the rock, and where the current issuing from them would meet with such resistance.

By an incision in the head ("the sponge") Prof. Schultze laid open its inner structure. The stem ("the coil") is continued, as in our sponge, deeply into it; and the spicules of the head, inserted among the larger ones of the axis in the form of flattened strings or blades, are regularly disposed all round "the axis." The figure (M. Schultze, 'Die Hyalonemen,' pl. 2. f. 1) shows, though rather indistinctly, this structure, which accords well with that of our sponge. The parenchyma of the specimens examined by Prof. Schultze, was very much diminished by drying.

It is evident that the stem ("the coil") of all the specimens of *Hyalonema* described has been torn off at its free end. Professor Schultze expressly states that its long needles are all broken; they are of the same type of form as those of our sponge—spindle-shaped, more or less round, thickest at the middle, tapering towards both ends, and somewhat spirally bent. The thickest part of many of the smaller and those of middle size has an inflation or nodule, in the interior of which the central canal gives off two short transverse canals, at right angles and in opposite directions. All this is as in our Sponge. From this simple primary type of spicule a number of secondary, more complicated forms are derived, almost without exception the same as in our Sponge, although in the latter not so fully developed. Such are the spicules with graduated ends (*l. c.* pl. 3. f. 5, 6, 7, our figs. 24, 25) or studded with short spines, into which the canal does not enter (*l. c.* pl. 3. f. 1–4, 9–15, our fig. 26), or with branches in two or four crossing directions (*l. c.* pl. 4. fig. 1, our figs. 14, 19); but those of *Hyalonema* are strongly and perfectly developed, forming six-rayed needles, or five-rayed ones where one part of the primitive needle is lost (*l. c.* pl. 4. f. 3, 5, 6). There can be a branch also in only one side (*l. c.* pl. 3. f. 15, to compare with our figs. 15, 18). Whether the arcuated spicules without nodules, found in the dermal layer of our sponge (figs. 6, 35), are to be recognized in the spicules figured by Prof. Schultze (pl. 3. f. 2, 3) may be left undecided.

Besides these affinities, there are also differences. In addition to the spindle-shaped needles, *Hyalonema* has also another type of siliceous spicules, which are not to be found in the specimens of our sponge I have examined. It is the type of

the amphidisci (birotulate spicula, Bow.) described and figured by Messrs. Bowerbank and Schultze. Spicules of this form are found, as far as hitherto known, among marine sponges, so perfect only in *Hyalonema*, and less perfect in *Halichondria* and in the freshwater genus *Spongilla*, where they are well known from the excellent and long-continued researches of Prof. Lieberkühn*. In this genus they enter into the composition of the envelope of the gemmules (ovaria, Bow.) in great number and in regular order. This kind of spicules accordingly is in connexion with the propagation. In *Hyalonema* Prof. Schultze searched in vain for such an arrangement; but this cannot be expected to be recognized in its primitive order in a dried specimen. If the specimens of our Sponge here described, so extremely small in comparison with the gigantic *Hyalonema Sieboldi*, were young, not yet prolific, or if the sexes were separated in this form of Sponges, the absence of the amphidisci might be explained.

The spindle-shaped needles of the stem of *Hyalonema* are of an immense length. The greater number of them reach from one end to the other; some of them are up to 0·67 metre long. The entire ones have their greatest thickness a little under the middle. The longest, though broken, needles have their thickest part nearer their free end. If this point is supposed to be at a distance of 0·5 metre from the end concealed in the interior of the sponge, then the longest needles, when entire, ought to have had the length of a metre, nearly eight times the longitudinal axis of the head. The longest needles of our sponge are not the fourth part of the length of the head. The stem of the Japanese sponge may have had the length of a single needle; thirteen needles of the longest in our sponge would not, if laid end to end, have attained the length of the stem, which is, however, not more than thrice that of the head. This great difference in the length of the needles cannot be entirely explained by the young state of the individuals; their character of incomplete development, however, appears, as already remarked, by the comparison between their secondary forms, which in our Sponge are much less developed; and the same character is probably also indicated by the circumstance that in our Sponge the nodule very seldom receives transverse branches from the central canal, which appears to be a common case in *Hyalonema*. It may also be remarked that in *Hyalonema* the deposition of siliceous layers in the longest needles has gone so far that the nodule at the middle has been outwardly quite concealed, while its

* Müller's Archiv, 1856, pl. 15. f. 28, 29, 30; Bowerbank, British Spongiadæ, figs. 208–222, 317–319.

innermost layers, by being bent, show that it existed when the needle was smaller. This may also possibly be an indication that the specimens of *Hyalonema* examined are old individuals.

The long needles of *Hyalonema* present a singularity first observed by Dr. Gray, and of which no trace is seen in our sponge. Their free ends have hooks placed in rings or spirals directed towards the thickest point of the needle. Professor Schultze expressly remarks that this cannot depend on the exterior layers having been partly broken. It is an uncommon case.

Professor Schultze, who described the oscula of the flattened surface of the head of his great *Hyalonema*, found this same surface in the smaller younger specimens covered by a network of spicules similar to that which covers the free end of *Euplectella cucumer*, Owen, and *E. aspergillum*, Owen*. Nothing similar is to be found in our sponge.

The head of the large specimen of *Hyalonema* examined by Professor Schultze shows a great number of circular holes, with a diameter of nearly a line, surrounded by bundles of fine siliceous needles, radiating in all directions from their edges. They are not at all to be found in our sponge. Professor Schultze regards them as "chimneys" (that is, oscula); but these are situated, as shown above, in *Hyalonema* as in our and many other species, on the free surface of the head. Pores for entering currents they cannot be. In their present form they are probably foreign to the structure of the sponge, tubes formed by the same parasitic zoophyte which Prof. Schultze discovered in their yellowish-brown clothing, and the urticating organs and arms of which he recognized.

In looking back on what is said above—the differences (which may depend partly on distinction of species or different ages, partly on incomplete observation), the affinities in the most important points (in the form of the head, with its great oscula on the free surface, the spicules in its interior radiating around the upper end of a stem composed of spindle-shaped siliceous needles)—it seems to follow that the little sponge which I have described, from the great depth of the North Sea, is a *Hyalonema* in its complete state, with its stem uninjured, and with its roots. But with regard to certain differences—the absence of amphidisci (which seem to belong to the propagation), the much shorter spindle-shaped needles and their little-developed secondary forms—it seems probable that the specimens I have described are young individuals of a

* *Loc. cit.* p. 9; Owen, Trans. Zool. Soc. iii. p. 203, pl. 13; Trans. Linn. Soc. xxii. pl. 21, see footnote, p. 118.

species of *Hyalonema* distinct both from *H. Sieboldi*, Gray, and from *H. lusitanicum*, Barboza du Bocage. In the present state of our knowledge of sponges, it is not advisable to make a new genus of it.

There exist between the fauna of lower animals living in the North Sea or fossil in the Crag formation, on one side, and that of the Japan seas, on the other, certain analogies which deserve to be kept in view. The crustacean *Geryon tridens*, for instance, described by Kröyer, which lives in the North Sea, always far from the shore, bears a very close affinity to the Japanese genus *Galena* of De Haan.

Hyalonema may be traced far back in geological time. The sponge from the Greensand figured as *Siphonia pyriformis*, Goldf., by J. de C. Sowerby *, has a strong resemblance to it; and Prof. Suess has recognized it in the *Serpula parallela*, M'Coy, of the Yorkshire Coal-formation †.

The genus *Hyalonema* may be characterized thus:—

HYALONEMA, Gray.

Spongia silicea; corpus clavatum in facie superiore applanata oscula gerens, stipite suffultum intrante, tereti, radiculis affixo. Spicula fusiformia stipitis ad longitudinem spiraliter et arte conjuncta parenchymate tenui; corporis in fasciculos radiantes congesta, interstitiis parenchyma lacunosum amplum continentibus; cuticulæ simplicia arcuata; amphidisci [gemmulas vestientes?].

1. *Hyalonema Sieboldi*, Gray.

Hab. in mari Japoniæ.

2. *H. lusitanicum*, Barboza du Bocage.

Hab. in mari Atlantico extra oras Lusitaniæ.

3. *H. boreale*, nob.

Hab. in mari septentrionali extra oras Norvegiæ, profunditate 200 orgyarum.

EXPLANATION OF PLATE VI.

Fig. 1. *Hyalonema boreale*, nob., magnitudine sesquies aucta.
Fig. 2. Facies superior cum osculo.
Fig. 3. Facies externa strati dermalis.
Fig. 4. Eadem, magnitudine auctiore.
Fig. 5. Spiculorum ejusdem congeries.

* Fitton, 'Strata below the Chalk,' p. 340, pl. 15 *a*.

† Verhandl. zool.-bot. Gesellschaft Wien, xii. p. 85. (Ann. Nat. Hist. ser. 3. xviii. 404.)

Fig. 6. Spicula singula.
Fig. 7. Stipitis sectio longitudinalis cum parenchymate.
Fig. 8. Stipitis pars, sublato strato dermali.
Figs. 9–11. Spicula fusiformia, simplicia.
Fig. 12. Apex spiculi.
Fig. 13. Sectio ejusdem.
Fig. 14. Spiculi pars media, ramis inchoatis canalem excipientibus.
Figs. 15–26. Spiculorum formæ secundariæ.
Fig. 27. Spiculum minutum simplicissimum, rarum.
Figs. 28–30. Spicula fracta, canali aëre repleto.
Figs. 31, 32. Sectiones longitudinales corporis.
Fig. 33. Finis stipitis in eodem, cum fasciculis spiculorum radiantibus.
Fig. 34. Ramuli ultimi fasciculi.
Fig. 35. Spiculum strati dermalis corporis.
Fig. 36. Parenchyma corporis.
Fig. 37. Radicis pars.
Fig. 38. Spongolithes in parenchymate radicis exceptus.

IX.—*List of Coleoptera received from Old Calabar, on the West Coast of Africa.* By Andrew Murray, F.L.S.

[Continued from vol. i. p. 333.]

[Plate VIII.]

Lycidæ (*continued*).

Metriorhynchus, Guérin-Ménev.

1. *Metriorhynchus sulcicollis.*

Lycus sulcicollis, Thoms. Arch. Ent. ii. p. 78.

I have received two species which, I believe, respectively belong to Mr. James Thomson's *Lycus sulcicollis* and *Lycus semiflabellatus*. His description of the former is as follows:—

"Prothorax of a brownish black, with yellow sides; elytra yellow, with the posterior fourth black; underside black; base of the thighs yellow.

"Very elongated, almost parallel in the male. Female with the antennæ very broad, almost pectinated. Prothorax with the anterior margin very projecting in the middle; sides lightly sinuated, posterior angles sharp; base strongly bisinuated, in the middle a very deep channel, changing into a ridge in front. Elytra each with four strong ridges, the intervals regularly reticulated.

"Length 7 to 11 millims., breadth $2\frac{1}{2}$ to 4 millims."

With all this my specimens agree; but they have also one or two other striking characters, which one would have expected to be mentioned if they were present. The black an-

tennæ, for example, have the terminal article of a pale yellow. The thorax, beside the ridge and groove, has four diverging minor ridges radiating from the middle ridge (fig. 1); and the reticulations of the elytra between each ridge are singly scalariform, as shown in fig. 2, and not doubly scalariform as in the next species.

Fig. 1.



Fig. 2.



2. *Metriorhynchus semiflabellatus.* Fig. 3.

Lycus semiflabellatus, Thoms. Arch. Ent. ii. p. 79.

Fig. 3.



Mr. Thomson's description of what I suppose to be this is as follows:—

"Above yellow, with the middle of the prothorax, the scutellum, and a little more than the posterior third of the elytra black; below, legs and antennæ black, as well as the base of the thighs, the middle of the metasternum and the last article of the antennæ yellow.

"Very elongated, slender, parallel. Antennæ very broad, with prolonged articles diminishing towards the extremity; prothorax angularly rounded in front, in the middle a ridge changing behind into a broad groove. Elytra straight on the sides, having each three strong ridges; intervals reticulated.

"Length $7\frac{1}{2}$ mill., breadth 2 mill."

The only difference between this and the description of the preceding species is that, while the elytra of *L. sulcicollis* have *four* strong ridges with the intervals "*regularly* reticulated," this has only *three* strong ridges with the intervals "reticulated," and that the scutellum of this species is black, while that of the other is not. The difference in reticulation is not alluded to; but the reader will see, on comparing fig. 4, which shows it in this species, with fig. 2 in the last, that it is an excellent distinction.

Fig. 4.



I am in doubt whether any difference is meant to be implied by the use of the different expressions "reticulated" and "regularly reticulated;" but the single scalariform interval appears more suggestive of regularity than the smaller and closer double scalariform interval, which is necessarily more crowded; and on that ground I have referred the "regularly reticulated" to *L. sulcicollis*; and I am the more supported in doing so by the scutellum (or, rather, the scutellar region) being black in it. The numerical difference of three strong ridges instead of four I cannot find: they all have four; and

I have come to the conclusion that the allotment of only three ridges to this species is a mistake on the part of Mr. Thomson. In all the allied Lycidæ the ridges are usually the same in number; and it seems by no means probable that in one section there should be two different species, so nearly allied to each other, yet having different numbers of ridges on the elytra. In many, however, and in particular in this species, the four ridges are not always observable at the base, the fourth being sometimes concealed or, rather, occupied by the shoulder; but nearer the apex they are all four always very visible.

Dascyllidæ.

PTILODACTYLA, Latr.

Ptilodactyla punctatostriata.

Nitida, castanea, elytris dilutioribus; thorace distincte et crebre leviter punctato; elytris punctato-striatis, interstitiis levissime sparsim punctatis.

Long. $2\frac{1}{2}$ lin., lat. $\frac{3}{4}$ lin.

Shining, chestnut-coloured, the elytra a little paler than the thorax. Head finely punctate and slightly pubescent. Thorax distinctly and (under a lens) rather deeply and thickly punctate, most closely on the sides and angles, not so closely but with larger punctures on the disk. Scutellum heart-shaped, with two raised lobes at the base, finely punctate. Elytra punctate striate, base and shoulders less so, the interstices finely punctate; the striæ disposed obliquely, except the sutural stria, which is straight; the shoulder separates two striæ, which unite about halfway down, those on each side of these again unite concentrically below them; the stria next to the sutural one is short, and fills a space left at the base by the oblique direction of the others.

This is another instance of the occurrence at Old Calabar of American forms (most nearly related to Brazilian types). *Ptilodactyla* is strictly an American genus, and has not hitherto been recorded as met with in the Old World.

COPTOCERA*, nov. gen.

(Fig. 5; and details, figs. 6–11.)

Mentum subtriangulare, apice truncato. Ligula quadrilobata, lobis duobus utroque latere conicis magnis ciliatis (fig. 6). Maxillæ lobo exteriore in duos lobos diviso rectos tenues et ciliatos; lobo interno lato, apice truncato, forsan semifisso

* From κόπτω, *I cut*, and κέρας, *a horn*, in allusion to the truncate termination of the last article of the antennæ.

margine interno (fig. 7). Palpi labiales et maxillares articulo ultimo subsecuriformi. Mandibulæ sat prominentes arcuatæ, apice fortiter bidentatæ (fig. 8). Labrum antice rotundatum (fig. 9). Caput declive; epistoma antice rectum. Oculi sat parvi parum prominentes. Antennæ (fig. 10)

Fig. 5.



Fig. 6.



Fig. 7.



Fig. 8.



Fig. 9.



Fig. 10.

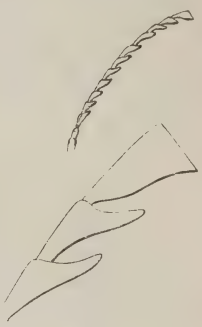


Fig. 11.

dimidio corporis longitudine, fere æquales, fortiter serratæ, articulo primo brevi sat parvo, secundo minuto, ceteris fere æqualibus latis, tertio parum longiore, ultimo truncato (fig. 11). Prothorax transversalis, postice latior, ad basin fere recte truncatus, parum bisinuatus. Scutellum postice rotundatum, sat magnum. Elytra lata, antice subparallela, pone medium dilatata, apice late rotundata. Pedes mediocres; tarsi mediocres, articulis primis quatuor trigonis, bilobatis, bilamellatis, lamellis latis et magnis, quinto unguiculis robustis. Carina prosternalis brevis et tenuis. Corpus crassum, convexum, postice parum dilatatum.

Coptocera gallerucoides.

Lævis, nitidissima, testaceo-ferruginea; antennis, apice mandibularum, palpis, tibiis tarsisque nigris. Capite antice oblongo, biimpresso, impunctato; thorace sat convexo, impunctato, disco bifoveolato, lateribus parum explanatis et reflexis, postice impressis. Scutello mitriformi. Elytris levissime seriatim punctulatis, stria suturali et stria laterali prope humeros fortius punctatis, lateribus bisinuatis, margine reflexo, humeris et disco ante medium et pone medium separatim elevatis. Subtus fulvo-pubescens.

Long. 9 lin.; lat. elytrorum ad basin $3\frac{3}{4}$ lin., pone medium 5 lin.

Smooth, very shining, testaceo-ferruginous, with the antennæ, the palpi, the apex of the mandibles, and the tibiæ and

tarsi black. The head impunctate, biimpressed in front. The thorax rather convex, impunctate, with the disk bifoveolate and the sides somewhat expanded and reflexed, and impressed near the posterior angles, which, although acute on the great scale, are inflexed and rounded at the tip, the anterior angles obtuse and rounded at the apex; base nearly straight. Scutellum mitre-shaped. Elytra very faintly impressed with a series of punctures in rows; but there is a sutural line or stria and an anterior marginal one, both of which are pretty deep and strongly punctate; the sides are bisinuate, and the margins reflexed; the shoulders and the disk near the scutellum and before the middle, and the disk behind the middle, all separately raised into prominences. Beneath fulvo-pubescent, the pubescence longest on the metasternum. Abdomen rather flat and somewhat soft.

This species looks exceedingly like some of the tropical Gallerucidæ, as *Agelocera*, *Rhombopalpa*, &c. It does not appear to have been common, a few specimens only having been received.

Elateridæ*.

APHANOBIUS, Esch.

Aphanobius seclusus, Cand. Elat. iv. p. 322.

Several specimens received.

The genus *Aphanobius* has hitherto been supposed to be peculiar to the East. Ten species are described by Candèze. Of these, four are from the Mauritius and five from other parts of the Indo-Malayan district—Singapore, Java, India, China, &c.; the occurrence of the only other species (the present) at Old Calabar is, as I think, an evidence either of a connexion between Africa and India, or else of a great geological antiquity of the generic form. The presence of many other Indian forms in Africa makes the former the more probable explanation; and the greater diffusion of such Indian forms would seem to indicate that the connexion was probably of a much older date than that which seems to have existed between the west coast of tropical Africa and the opposite coast of Brazil.

CRATONYCHUS†, Boisd. & Lacord.

Cratonychus umbilicatus, Gyll., Cand. Elat. iii. p. 322.

This is the only species in the large genus *Cratonychus*

* All the Elateridæ which I had then received from Old Calabar were placed by me in Dr. Candèze's hands at the time he was engaged on his great work on that family, and were therein described. A few additional species have since been received.

† I do not agree with my friend Dr. Candèze in his reasons for abandoning the old name *Cratonychus* and substituting *Melanotus*.

which is found out of the limits of the northern hemisphere: all the rest come from Europe, Siberia, North America, &c. I think we must regard it as a straggler which has passed the barrier of the Sahara either before or after it became dry land. It appears to be distributed all over Africa proper, having been met with in Senegal, Guinea, Old Calabar, the Cape of Good Hope, and Caffraria.

CARDIOPHORUS, Esch.

Cardiophorus accensus, Cand. Elat. iii. p. 178.

One or two specimens received.

MELANOXANTHUS, Esch.

Melanoxanthus melanocephalus, Germ. Zeitsch. v. p. 191; Cand. Elat. ii. 512.

Elater melanocephalus, Thunb. Nov. Spec. Ins. Diss. iii. p. 63; Oliv., Fab., Herbst, &c.

Var. *subsuturalis*.

This species seems nearly cosmopolitan. It is found, not rarely, in Brazil. It occurs in India, the Malaccas, and generally in all the tropical regions of Asia from Arabia to China. It has also been met with in Madagascar and the Mauritius, and Bourbon Island.

The specimen (only one) which I have received from Old Calabar agrees with the ordinary type, with the exception that the black mark on the thorax is a little wider and extends further back on the thorax, and that the black apex of the elytra extends further up them and runs narrowly and feebly up the suture for a short space. I have therefore treated it as a variety.

HETERODERES, Latr.

Heteroderes coctus, Cand. Elat. ii. p. 366.

This is one of the commonest of the Elateridæ of Old Calabar.

ISCHIODONTUS, Cand.

Ischiodontus monachus, Cand. Elat. ii. p. 120.

One specimen received.

PSEPHUS, Cand.

§ 1. Third article of antennæ smaller than the fourth.

1. *Psephus limonioides*.

Generi *Limonio* facie similis (ex. gr. *Limonio fulvipilis*, Cand.), fusco-niger, parum nitidus; fronte convexa, antice im-

pressa, breviter fulvo-pilosa, fortiter punctata; prothorace parum elongato, profunde ac dense punctato, convexo, postice breviter canaliculato, sat longe præsertim lateribus et disco fulvo-piloso, angulis posticis longis et parum divaricatis; elytris punctato-striatis, interstitiis subrugose granulatim punctatis, fulvo-pilosis; antennis nigris; pedibus testaceo-ferrugineis.

Long. $4\frac{1}{2}$ lin., lat. $1\frac{1}{3}$ lin.

Similar in general appearance to the genus *Limonius*, and more especially to the *Limonius fulvipilis*, Cand. Subcylindrical in form, fuscous black, slightly shining. Head thickly and strongly punctate and fulvo-pilose, convex, with a well-marked transverse impression close to the margin of the keel. Antennæ black or brownish black, with the second and third articles minute. Prothorax deeply and very closely punctate, fulvo-pilose, especially on the sides and disk, convex, with a short distinct smooth canaliculation behind, longer than broad, narrowest in front; sides sloping to the front, where they are rounded in; the posterior angles long and slightly divaricated, keeled along their outer margin, also shortly in the middle and on their inner margin, sharp at the apex. Scutellum elongate pentagonal. Elytra of the breadth of the thorax, nearly parallel or very slightly dilated until beyond the middle, not very much attenuated at the apex, punctate striate, the striæ not very strongly punctate, the intervals flat, subrugosely granularly punctate. Legs testaceo-ferruginous, fusco-pubescent. Lamellæ on the second and third tarsi only.

Three specimens received.

2. *Psephus brevipennis*, Cand. Elat. ii. p. 27.

Several specimens received.

3. *Psephus macrophthalmus*, Cand. Elat. ii. p. 26.

Only one individual received.

4. *Psephus elimatus*, Cand. Elat. ii. p. 22.

Only one specimen received.

§ 2. Third article of the antennæ as large as the fourth.

5. *Psephus conicollis.*

Fuscus, parum nitidus, griseo-pilosus; fronte fortiter sat dense punctata, convexa, antice impressa; prothorace convexo, sparsim subleviter punctato, postice leviter canaliculato, latitudine majore, ab angulis posticis sensim angustato, angulis posticis carinatis; elytris leviter punctato-striatis, in-

terstitiis planis, granulatim subrugosis; subtus castaneus, abdomine parum dilutiore; pedibus castaneis, tarsis secundis et tertiis lamella instructis.

Long. 4½ lin., lat. 1½ lin.

Conical in front, and conical or subcuneate behind. Fuscous, slightly shining, griseo-pilose. Head convex, impressed in front, rather coarsely and somewhat densely punctate. Prothorax broader than long, convex, faintly punctate (most so in front), and clothed with a longish pubescence, with a slight longitudinal canaliculate depression behind, gradually narrowed from the posterior angles to the anterior angles, the posterior angles carinated. In one of my specimens the exterior outline of the posterior angles is slightly rounded, which may be a sexual difference. Scutellum elongate, mitre-shaped. Elytra wedge-shaped or conical at the base, nearly as broad as the base of the thorax, gradually attenuated to the apex, feebly punctate striate, the intervals flat, subgranulously transversely rugose. Below chestnut, darkest on the thorax; metathorax thickly punctured all over, rather deepest on the sides, the punctures so close to each other as to meet. Legs chestnut. Lamellæ on the second and third tarsi.

Two specimens (probably male and female) received.

6. *Psephus nitidus.*

Statura *P. conicolli*, minor, rufo-castaneus, nitidus, vix pilosus, fronte punctata; prothorace leviter punctato, postice fere impunctato; elytris levissime striato-punctatis, interstitiis parum elevatis, transversim subrugosis.

Long. 3¾–4 lin., lat. 1 lin.

Similar in form and sculpture to *Psephus conicollis*, smaller, reddish chestnut, almost without hairs, shining. Head punctate, anteriorly very slightly depressed. Prothorax conically rounded to the front, finely and sparingly punctate, more especially behind, posterior angles rounded in, carinate. Scutellum elongate, mitre-shaped. Elytra very finely punctate striate, interstices slightly elevated, transversely granulously subrugose. Underside and legs same colour as the upperside. Metathorax very coarsely punctured on the sides, but finely punctured on its disk, the punctures scattered and not touching each other.

Only one specimen received.

7. *Psephus striatopunctatus*, Cand. Elat. ii. p. 21.

Several specimens received.

8. *Psephus beniniensis*, Cand. Elat. ii. p. 21.

Only one or two specimens received.

Olophæus, Cand.

Olophæus gibbus, Cand. Elat. ii. p. 15.

This varies considerably in size, some being very nearly twice the size of others.

Tetralobus, Lepell. et Serv.

1. *Tetralobus Chevrolatii*, Cand. Elat. i. p. 374.

In my specimen I observe one character not noticed by Candèze in his description, viz. that the spine of the prosternum is deeply canaliculate.

One specimen.

2. *Tetralobus subcylindricus.*

Nigro-brunneus, pube fulvo-sericea brevissima sat dense vestitus, punctatissimus, elongatus, elytris subcylindricis; fronte punctata, postice linea lævi carinata, antice excavato, carina frontali transversali subrotundata; prothorace crebre et sat fortiter punctato, inæquali, subquadrato, antice lateribus rectis et parallelis, angulis anticis rotundatis, angulis posticis divaricatis, apice retrorsum flexis, subtus grosse sparsim punctatis; elytris subparallelis, prope medium levissime dilatatis, creberrime leviter punctatis, haud striatis, obsoletissime nervatis, apice angulis suturalibus rotundatis; subtus mesosterno et metasterno sat longe fulvo-pilosis; abdomine fulvo-sericea pube vestito, ischiis fere parallelis, transversim depressis, interne parum incisis, vix dentatis.

Long. 19 lin., lat. 6 lin.

Brownish black, clothed with an excessively short but dense silky fulvous down, thickly punctured, elongate, rather narrow, transversely convex, so as to appear almost subcylindric, at least as regards the elytra. Head rather coarsely punctate, behind with a slight smooth raised line, in front with a deep longitudinal excavation; the frontal transverse keel subrotundate, in some aspects like a truncate triangle with the corners rounded and the middle slightly sinuate. The prothorax closely and rather coarsely punctate, unequal on its surface, slightly depressed on each side of the middle in front, also on the disk, and on each side behind the middle, and with a small oblique distinct fovea near the posterior angles; the sides parallel, margins rounded in, anterior angles rounded, posterior strongly divaricate, with their apex slightly incurved, and with a small raised tubercle in their middle; base with a lobe in front

of scutellum. Scutellum rounded at the base, wedge-shaped at the apex. Elytra convex, subcylindrical, subparallel, a very little dilated about the middle, very thickly and finely punctate, without striæ, but with some obsolete traces of nervures near the base; sides with a slight bent keel at the base, the sutural angle at the apex rounded. Underside of prothorax much more coarsely, but not nearly so closely punctate as the upper surface, the spine with a slight appearance of keel on each side near the base; the mesosternum and metasternum clothed with rather long fulvous hair; the abdomen with fine down only, as on the upperside. The posterior haunches are of nearly equal breadth throughout, with a transverse depression of no great depth; the free margin at the inner end slightly notched, but very slightly, if at all, toothed.

Only one specimen received. It is most nearly allied to *T. punctatus* from Senaar, both having the thorax very much punctate; but its shape is different, and the elytra in this species are not nearly so much costate as in *punctatus*.

Alaus, Esch.

Alaus Candèzei.

Niger, squamulis cinereis cervinis fuscisque marmoratus; antennis haud longitudinem thoracis æquantibus, fuscis, articulis primis tribus nitidis et pubescentibus, ceteris opacis et velutinis, valde serratis; prothorace latitudine longiore, lateribus parum depressis, sinuato, parallelo, angulis posticis divaricatis, carinatis, apice retrorsum flexis; elytris pone humeros et postice depressis, antice fortiter punctato-striatis, versus apicem punctis levioribus instructis, apice subemarginato, angulis externis rotundatis, suturalibus submucronatis; subtus pube magis concolori vestito; mesosterno et metasterno pilosis; abdomine segmentorum marginibus extus subdenticulatis.

Long. 14 lin., lat. 4½ lin.

Black, densely clothed with ashy and fawn-coloured scales, marbled and peppered with brown. Antennæ very strongly serrate, brown, the first three articles shining and pubescent, the remainder opaque and velvety. Head concave in front. Prothorax longer than broad, disk most convex behind the middle, with the sides subparallel, sinuate, and somewhat depressed; anterior margin bisinuate; posterior angles diverging, keeled, their apex slightly incurved. Scutellum sloping more in front than behind, obovate. Elytra depressed towards the apex and behind the shoulders, punctate-striate, the punctures distinctly apart from each other, deepest outside the shoulder, less deep

towards the suture, and gradually diminishing as they approach the apex, which is subemarginate, with the external angles rounded and the sutural angles turned outwards and feebly mucronate. Below more uniform in tint; the mesosternum and metasternum pilose; the abdomen with the margins of its segments subdenticulate at the external angle. In the female the pencilled margin of hairs on the free margin of the last segment of the abdomen is composed of singularly shaped hairs, somewhat club-shaped, or like an irregular knob on a thin stalk—cherries on a stalk, in fact, only the cherries are not round.

The African species to which this comes nearest is *A. senegalensis*; but it differs in the prothorax not having a broad longitudinal median canal, in there not being a tubercle on it in front of the median lobe, in the sides being sinuate instead of rounded, in the elytra not being tubercular at their base, in their apex not being bidentate, and in their third interval not being more raised than the others. It has more resemblance, however, to some of the Malayan species.

Only one specimen (a female) received.

Lacon, Lap.

Lacon sordidus, Cand. Elat. i. p. 114.

Of this species I have one specimen, given to me by Mr. Fry, who had acquired it from Mr. Gray, of Glasgow, with the locality marked as Old Calabar. Mr. Gray was in relations with my friends the missionaries, and I have no doubt that his locality is to be depended on. The only habitat given by Candèze for the species is Senegal.

My specimen is probably immature, being chestnut-coloured instead of black. It may be worth mentioning, as a character not noticed by Candèze, that the scales on the elytra are disposed in pairs on the intervals between the striæ, and are arranged obliquely, pointing backwards towards each other, so that it gives them the appearance of a plaited flat rope.

Dilobotarsus, Latr., Cand.

Dilobotarsus cornutus, Cand. Elat. Nouv. p. 8 (1864).

Castaneus, elytrorum apice ochraceo, pilis albidis et ochraceis hic et illic sparsim irroratus, lineari-elongatus, angustus, subcylindricus; fronte excavata, luteo-squamulosa; prothorace inæquali, antice latiore, lateribus sinuatis, apud marginem anticum tuberculis duobus, transversim granulose multistriolato; elytris anguste linearibus, granulose crebre

punctatis, obsolete nervosis, basi pilis ochraceis obductis, fascia saturatius castanea ante apicem pilis albidis et postice pilis ochraceis marginata, altera fascia interrupta vel potius linea tenui transversa interrupta punctorum albidorum paulo pone scutellum; antennis pedibusque castaneis. Long. 5 lin., lat. $1\frac{1}{8}$ lin.

Chestnut, with the apex of the elytra paler or ochraceous and a band immediately before the lighter space darker chestnut, and here and there spattered with whitish and ochreous scales; linear-elongate, narrow, subcylindric; the head excavated in front, clothed with yellowish-white hairs. Prothorax broadest in front, unequal, with depressions on the sides and in front of the scutellum, and with two rather large tubercles near the anterior margin; sides sinuate, covered with numerous transverse fine granulous striæ, giving the effect of punctures. Scutellum black, deeply sunk in the elytra, nearly vertical, elongate, with the apex rounded and somewhat knobbed. Elytra narrowly linear, granulously thickly finely punctate, obsoletely costate, clothed with ochraceous hairs on each side of the scutellum, and with two interrupted slender bands of white scales, the anterior one a little behind the scutellum, confined to one or two small spots of white hairs or scales, the posterior immediately in front of the darker band of chestnut, which is just before the pale apex; the anterior margin of this pale apex is clothed with ochreous-yellow scales, which gives a light border to each side of the darker band, making it appear darker in colour than it really is. The antennæ and legs chestnut. Underside of body brown, except the sides and margins of the sutures and segments of the abdomen, which are chestnut.

The above description was written before I saw that given in Dr. Candèze's 'Elatérides Nouveaux,' and I have allowed it to stand, as perhaps useful to some as a second description, and at all events convenient to those who may not possess the Supplement to Dr. Candèze's 'Elateridæ,' which has been published under the above title in the Mémoires of the Roy. Acad. of Brussels.

This is another instance of the occurrence of Brazilian forms at Old Calabar. No *Dilobotarsus* has previously been found out of South America; and as it is a genus of remarkable characters and striking form, there is no room for referring its affinity to some other type which may occur in the Old World. It is what I should term a crucial example of the occurrence of a purely American form in Africa proper. But another noteworthy circumstance is, that this species is not (as is the case with most of the strictly American forms which we have

recorded from Old Calabar) confined to the west coast of Africa, but is also found on the east coast. I know of three specimens in different collections—my own from Old Calabar, one from Natal, in the collection of Mr. Janson, from which Dr. Candèze's description was taken, and one from Algoa Bay, in the collection of Mr. Wilson Saunders, nearly twice the size of (but still the same as) the other two.

Eucnemidæ.

Oisocerus*, nov. gen., De Bonvoul.

This remarkable genus has not yet been published; and I had intended that its first appearance should be in M. de Bonvouloir's work on the Eucnemidæ, on which he has been for some time engaged. As, however, I have now reached the place in my list where it comes in, I have asked my friend M. de Bonvouloir to favour me with an advance copy of his description, which he has kindly done; so that I am able to give the reader that eminent entomologist's own description of this giant of his group, in anticipation of that in the work itself:—

"Genus Oisocerus.

"Head strongly convex, tolerably deeply sunk in the prothorax; epistome continuing directly the curve of the forehead, forming a very obtuse angle with the latter, and consequently distinctly bent in as regards the head, slightly narrowed at its base, with its anterior margin arched in front. Mandibles only showing exteriorly a surface transversely arched and narrow, very much crossed, with a long and sharp point. Antennæ distinctly shorter than the half of the body, more or less strongly flabellate. Pronotum short, strongly attenuated in front; marginal ridges and prosternal sutures converging in front. Propectus not canaliculated below along the external ridge, showing laterally a single marginal line obliquely converging in front, starting from the posterior angles and reaching the anterior angles, deflexed, without another supplementary line. Propleura tolerably broad, subtriangular. Prosternal sutures rectilinear. Prosternum without mentonnière, with its anterior margin raised in a keel very slightly sinuated in the middle. Metathoracic episterna subparallel; epimera invisible. Posterior haunches furnished with an upper transverse blade tolerably narrowed on the outer side, and raised above the abdominal surface so as to leave a free passage for the thighs to rest in. Legs rather narrow, scarcely thickened

* From *οἶσός*, a willow, and *κέρας*, a horn, in allusion to its flabellate antennæ.

at the summit. Tarsi cylindrical, with the penultimate article simple.

"This genus is extremely remarkable, not only by its facies but by its characters, and cannot be confounded with any other of the family of Eucnemidæ. It appears to approach a little to the genus *Phlegon*, but is distinguished from it very easily by the structure of its antennæ as well as by the penultimate article of its tarsi being simple.

" *Oisocerus Murrayi*, Be Bonv. Pl. VIII. fig. 5.

" Oblongo-elongatus, postice tantum leviter attenuatus, obscure brunneus, supra pube fulvescente brevi dense vestitus; capite sat fortiter dense rugoseque punctato, clypeo medio valde excavato; antennis pronoto multo longioribus longiusque flabellatis articulo tertio flabellato (♂), vel pronoto vix longioribus brevius flabellatis articulo tertio dentato (♀); pronoto latitudine multum breviore, lateribus sinuato, basi media bipunctato, medioque foveis duabus sat profundis notato, minus fortiter dense rugoseque punctato; elytris distincte striatis, interstitiis leviter dense transversim rugose punctatis; lobo prosternali basi depresso; pedibus rufo-brunneis.

" Long. 9–10 lin., lat. 3½ lin.

" Body oblong-elongate, slightly attenuate in its posterior third only, slightly convex, of a reddish brown, somewhat opaque, covered above with a yellowish short and dense pubescence. Head tolerably distinctly punctate, punctuation very close and rugose. Epistome slightly narrowed at the base, distinctly broader than the space between it and the eye, strongly excavated transversely in its middle. Forehead scarcely visibly depressed in its midst in front, marked in some with a small longitudinal keel extending backwards to the vertex, and absent in others. Antennæ very short, passing distinctly (♂) or scarcely (♀) the posterior angles of the pronotum; in the ♂ the third article is prolonged in a very elongated compressed branch, about twice as long as the first two articles united, the remainder similarly prolonged, with their branches becoming gradually longer towards the extremity, the last subequal to the preceding; in the ♀ the third article is simply prolonged into a strong internal tooth, which is nearly equal to the rest of the article, the fourth into a narrow branch of the length of the first two articles united, the remainder similarly prolonged, and gradually becoming a little longer towards the apex; in both sexes the antennæ are covered by a very close yellowish pubescence. Pronotum nearly twice as broad as long, sufficiently distinctly attenuated in front and very distinctly sinuated on each side above the

posterior angles, which are strongly prolonged behind, with a punctuation a little less strong than that of the head, but very dense and very rugose; marked in the midst of the base with two small punctiform depressions, and with a longitudinal line which reaches the anterior margin; moreover, marked on each side in its middle by a transverse or subrounded, tolerably large and very deep depression. Scutellum elongate quadrate. Elytra oblong, subparallel, slightly attenuated in their posterior third, very distinctly striated, their intervals scarcely convex, finely, very densely, and very rugosely transversely punctate. Underside of body of a deeper reddish-brown colour. Propectus tolerably distinctly and not very densely punctate in the middle, more rugosely on the sides. Prosternal projection rather strongly depressed in the middle of its base, with its sides somewhat raised, very slightly narrowed in its posterior half, and almost subrounded behind, then abruptly and strongly inflexed and terminated below in a sharp point. Abdomen very finely, very densely, and somewhat rugosely punctate. Legs and tarsi of a deep reddish brown."

Apparently rare, only a few specimens having been received.

Buprestidæ.

Corœbus, Cast. & Gory.

1. *Corœbus nodifrons.*

Ænescenti-brunneus, subopacus, subpunctatus, aciculatim rugosus, pube cinerea et nigra irregulariter vestitus; elytris pube nigra bifasciatis prope apicem, et versus apicem pube ochracea notatis; capite nodoso; thorace impresso; elytris apice denticulatis; subtus nitidus, æneus, fulvo-pubescens, aciculatim rugosus.

Long. 5 lin., lat. $1\frac{1}{3}$ lin.

Brown, with a slightly greenish brassy tinge only visible from some points of view, subopaque, subpunctate, acicularly transversely rugose, clothed with a fine longish grey or ash-coloured pubescence, irregularly mixed with black, which is disposed in two bands near the apex of the elytra, where a few ochraceous hairs occur both on the black bands and along their sides. Head vertical, with the epistome slightly raised, being divided off by oblique grooves on each side; from it a deep longitudinal groove runs back to the vertex, making two longitudinal tubercles highest behind on each side of the head, which, however, are slightly interrupted, so that from some points of view there would appear to be four tubercles besides the epistome, while from others there only appear two, which

are very prominent when seen from behind. Eyes moderate. Thorax subquadrate, unequally impressed, a large fovea in the lobe in front of the scutellum, two others placed obliquely on each side of it, a transverse one in front, and a triangular one on the inflexed side, which is sinuate; posterior angles obtuse, and posterior margin of median lobe truncate, straight. Scutellum triangular. Elytra with the shoulders not very prominent, and the apex fimbriated with fine denticulations. Underside shining æneous, fulvo-pubescent, acicularly rugose.

One specimen.

(Subgen. *Polyonychus*, Chev.)

This subgenus is not accepted by Lacordaire nor by Kiesenwetter, although the former so far inclines to adopt it as to point out the characters which distinguish it from *Corœbus*, and the latter divides *Corœbus* into two sections, of which the one has the characters of *Corœbus* as restricted by Chevrolat, and the other those of this genus (*Polyonychus*). Although the seizable generic characters are trifling, the difference in facies is tolerably marked; and I therefore think it a useful section, worthy of being preserved, particularly in a family which is so numerous, and of which the species are so much alike as the *Agrilidæ*. The true *Corœbi* are the broader flat species with irregular patches or bands of different coloured pubescence, of which *C. rubi* may be taken as the type, while the more uniformly metallic and less banded species, such as *C. elatus*, compose the genus *Polyonychus*. It is to be observed, however, that the name is not happy; for both *Corœbus* and *Polyonychus* have equally the claws of the tarsi split in two.

2. *Corœbus* (*Polyonychus*) *viridanus*, Cast. & Gory, Monogr. Bupr. t. 3. f. 15.

One specimen.

3. *Corœbus* (*Polyonychus*) *sophoroides*.

Agrilo Sophoræ affinis, thorace antice latiore; elytris apice et fascia prope apicem pilis albidis leviter et sparsim obtectis. Long. $2\frac{1}{4}$ lin., lat. $\frac{1}{2}$ lin.

This species differs in the following respects from Castelnau and Gory's description and figure of *Agrilus Sophoræ*, to which it was referred by some continental entomologists to whom I sent it. In the first place the tarsi are short, more especially the first article, which is inconsistent with the genus *Agrilus*, in which Castelnau and Gory place *Sophoræ*. Passing that, it is, like it, a small bright-green insect like an *Agri-*

lus, but, although more elongate than most of the *Coræbi*, has a good deal of the facies of that genus. Its surface is very granular, and the head has a slight impression in the middle. The thorax may be said to be nearly square, but is certainly not broadened behind, as said by Gory, but in front. As in *A. Sophoræ*, its disk is convex in front, with a strong transverse impression behind, and a hollow which comes from each side to unite with the posterior angles, which are sharp; but the bottom of this hollow space is not purple, but of a brilliant fiery copper or brassy green; that, however, is not a point of any importance; neither, perhaps, is it that the underside is black, with very little æneous hue, instead of being bronzy. The legs, too, nearly correspond, being (especially the posterior ones) of a bright coppery golden hue, which is near enough to Gory's description—"a brilliant golden green." But Gory takes no note of a peculiarity which could not fail to strike him had it been present in his species, viz. that there is a transverse band of whitish scales near the apex, and the apex itself is clothed with similar scales.

It is possible enough that this *may* be Gory's *A. Sophoræ*, and that the differences which I have pointed out are due to his having had rubbed specimens to describe from, or to errors in his description: but I am not entitled to take this for granted; and as it certainly does not agree with his description, nor with his figure, I have no alternative but to describe it anew under a fresh name. Whether it is new or not, I think there is no doubt that it ought to come into the metallic section (*Polyonychus*) of the *Coræbi*, and that it does not properly belong to the genus *Agrilus* as restricted either by Lacordaire or by Gory himself.

Agrilus, Curtis.

1. *Agrilus ignicollis.* Pl. VIII. fig. 1.

Sat crassus, supra viridis, thorace cupreo-rubro, subtus niger, pallide pubescens; capite convexo, levissime aciculato, leviter longitudinaliter impresso, canali angusto secus marginem interiorem oculorum, oculis minus convexis; thorace antice latiore, transversim plicato, angulis posticis obtuse rotundatis, angulis anticis projicientibus; elytris aciculatim punctatis, apice cuneato-truncato, denticulato, fascia parva apicali albido-piloso; tarsis primo articulo sat longo.

Long. $3\frac{1}{2}$ lin., lat. $1\frac{1}{4}$ lin.

Rather stout; above bluish green, with the thorax fiery copper; below bluish black, with a slight pale pubescence.

Head convex, faintly aciculated, slightly impressed longitudinally, and with a narrow canal on the inner margin of the eye; eyes rather flat. Thorax without impressions, narrowed behind, transversely plicate, with the posterior angles obtusely rounded, the anterior angles projecting, anterior margin sinuate; posterior basal median lobe moderate. Scutellum broad and ridged in front, acuminate behind. Elytra acicularly punctate, with the apex cuneate-truncate, denticulate, and clothed with a small band of whitish pile. Underside acicularly punctate, with a frequent short pale pubescence. Tarsi moderate in length, the first article long, longest in the posterior tarsi.

Several specimens received.

2. *Agrilus Bonvouloirii.*

Subopacus, capite et thorace brunneo-ænescentibus, elytris viridibus; elongatus, capite et thorace aciculatim transverse plicatis; elytris subrugose aciculatim punctatis; subtus æneo-cupreus.

Long. 5 lin., lat. 1 lin.

Above somewhat dull; head and thorax brownish brassy; elytra green, with a purplish tinge when looked at horizontally from before or behind; the underside shining greenish coppery brassy; elongate, nearly of the size and shape of *Agrilus biguttatus*, but a little smaller and more attenuated in front. Head irregularly transversely and obliquely acicularly plicate, the plicæ curved; a narrow longitudinal depression down the forehead, and a narrow canal along the inner margin of the eye. Thorax transverse, transversely finely plicate, unequal, broader than long, slightly narrowest in front; anterior margin nearly straight, sides subparallel; basal margin with the median lobe short, broad, and its sides oblique, a curved raised space at each posterior angle, with a sinuate depression winding round in front of it. Scutellum broad at the base, with a transverse basal ridge, acuminate at the apex. Elytra acicularly subrugosely punctate, with a basal triangular fovea at the inner side of the shoulder, slightly expanded behind the middle; apex conical, sharply denticulate. Underside bright shining greenish coppery brassy, bluish under the thighs, acicularly punctate, the segments of the abdomen not much more thickly punctate in front than behind. Tarsi as long as the tibiæ, first joint as long as all the rest put together.

One specimen.

3. *Agrilus capensis.*

A. Bonvouloirii affinis, forsan varietas ejus, fronte magis ex-

cavata; elytris postice purpureis; abdomine segmentis crebre antice punctulatis.
Long. 4 lin., lat. $\frac{3}{4}$ lin.

This may be a small variety or one of the sexes of *A. Bonvouloirii*; but there are one or two points of distinction which seem to me to warrant its being provisionally described as distinct. It is smaller, and the elytra are purple behind, that colour encroaching more or less on the green at the base; the head is more deeply excavated; the scutellum is bi-ridged transversely at the base, and the segments of the abdomen are finely and closely punctate along the anterior margin.

Several specimens have been received. I am informed by Mr. Edward Saunders that in some cabinets it stands under the unpublished name of *A. capensis*, which I have preserved.

4. *Agrilus Saundersii.* Pl. VIII. fig. 2.

Ænescenti-olivaceus, apice parum cupreo; elytris punctis, sex albido-pilosis (duobus ad basin, duobus ante medium, duobus propinquioribus post medium) instructis.
Long. $3\frac{1}{2}$ lin., lat. $\frac{3}{4}$ lin.

In general appearance similar to *Agrilus sexguttatus*, but smaller and narrower in proportion, also similarly marked with six small spots of white scales. Brassy olivaceous, slightly coppery at the apex of the elytra; surface finely granulous. Head with the forehead very prominent, and with a longitudinal groove separating it into two lobes. Thorax subquadrate, slightly widest in front, transversely finely acicularly rugose, behind with a broad transverse curved depression concave to the front, with a slightly deeper impression in the middle and another on each side. There is also a somewhat curved impression near the middle in front; median lobe short, curved. Scutellum small, triangular. Elytra finely granular, with a small depression, full of whitish scales, at the inner angle of the shoulder; and a larger median depression, filled with whitish scales, somewhat before the middle, and a still larger one (although all actually small) behind the middle and closer to the suture; the apex doubly emarginate, more deeply next the suture, with a large tooth at the sutural angle and another at each of the external angles: exterior to this external tooth there are one or two minute denticulations. Underside and legs greenish brassy, sparingly clothed with a longish whitish pubescence. The upper margins of the segments as seen beyond the elytra clothed with whitish pubescence. Posterior tarsi with the first article equal in length to the three following; in the anterior tarsi the first article not quite so long.

Two or three specimens.

I have named this species after Mr. Edward Saunders, in recognition of the services he has already done in rescuing a portion of the Buprestidæ from the confusion in which they lay—services which all entomologists must hope will be continued and extended to other groups.

Mychommatus*, nov. gen.

Caput parum excavatum, secus marginem internum oculorum canaliculatum; epistoma antice parum emarginatum. Antennæ breves, articulis primis, secundis et tertiis obconicis, primis majoribus, secundis et tertiis æqualibus, ceteris fortiter serratis, transversis, undecimis emarginato-truncatis. Prothorax depressus, brevis, transversalis, lateribus canaliculatis, postice latior et medio lobato. Scutellum sat magnum, planum, transversum pentagonale, antice arcuatum. Elytra elongata, disco plano et subdepresso, a basi ad apicem gradatim attenuata, apice parum expanso, rotundatim truncato, dentibus fimbriato. Ischia postica margine antico excavato, margine libero late curvatim emarginato. Tibiæ posticæ extus pilo fimbriatæ, anticæ simplices; tarsi sat robusti, lamellis omnes instructi, articulis brevibus, postici articulo primo parum elongato, ceteri fere æquales: unguiculi sat fortes, breviter fissis. Metasternum antice protensum, medio profunde emarginatum. Prosternum depressum, antice truncatum, postice projiciens. Corpus elongatum, depressum, cuneatum.

This genus has the cuneiform facies of *Stenogaster*, differing apparently only in being smooth and shining, instead of unequal and marbled with irregular pubescence, &c.; and *Stenogaster* being wholly Brazilian, at first I regarded it as another instance of the presence of a South-American form on the west coast of Africa; but the presence of lamellæ on all its tarsi removes it from that category. Its facies, however, seems to require the establishment of a new genus for its reception, the shortness of the tarsi preventing its taking a place among the *Agrili*, which it most resembles in form.

Mychommatus cyaneus. Pl. VIII. fig. 3.

Nitidissimus, et supra et subtus læte cyaneus, elytris violaceo-cyaneis; capite leviter sparsim punctato; prothorace parum fortius punctato, disco fere impunctato, angulis posticis subrectis; scutello impunctato; elytris sparsim leviter punctatis,

* From *μυχὴ, a recess*, and *ὄμμα, the eye*, in allusion to the canal along the inner margin of the eye.

striis irregularibus, sutura depressa et leviter lineata, humeris elevatis, lateribus sinuatis, apice denticulato, angulis suturalibus leviter mucronatis; subtus leviter transversim rugoso-punctatus, albidis setis minutissimis instructus.
Long. 6 lin., lat. $1\frac{1}{3}$ lin.

Bright and shining, rich blue both above and below, the elytra violet-blue. Head very faintly and sparingly punctate; thorax a little more strongly punctate, but still very sparingly, a little more thickly in front, and almost impunctate on the posterior part of the disk; posterior angles nearly right-angled, basal lobe emarginate. Scutellum impunctate. Elytra sparingly and finely punctate, the punctures arranged somewhat longitudinally; shoulders rather prominent, an irregular depression inside of them; suture depressed, and with a fine line along it, and denticulate at the apex, about seven to nine denticuli fringing the rounded apex of the elytra. Underside finely transversely rugose, finely punctate, and bearing very minute whitish scales or setæ.

One specimen.

BELIONOTA, Esch.

Belionota Championi, Murr. Trans. Linn. Soc. 1862, xxiii. p. 451. Pl. VIII. fig. 4.

Not rare.

PSILOPTERA, Sol.

Psiloptera piperata, Murr. Trans. Linn. Soc. 1862, xxiii. p. 451. Pl. VIII. fig. 7.

Not very rare.

CHRYSOCHROA, Sol.

Chrysochroa elongata, Fab. Syst. Eleuth. t. ii. p. 200; Cast. & Gory, Buprest. i. p. 10.

One specimen received.

CHRYSODEMA, Cast. & Gory.

Chrysodema chrysochlora, Pal. de Beauv. Ins. recueill. en Afriq. et en Amér. 1805, p. 44; Cast. & Gory, Bupr. iv. p. 68. Pl. VIII. fig. 6.

One specimen.

Notwithstanding the great authority of Prof. Lacordaire, I cannot bring myself to merge the old genus *Chrysodema* with the typical *Chalcophora*, and therefore still keep Palisot de Beauvois's *C. chrysochlora* under the former genus.

[To be continued.]

X.—*Carcinological Gleanings.* No. IV.

By C. Spence Bate, F.R.S. &c.*

[Plates IX., X., XI.]

The entrance to the English Channel appears to be the boundary or extreme limit of two distinct faunas. We find species that are decidedly arctic in their character represented by specimens that have a generally depauperized appearance, both as to size and typical expression, while Mediterranean species are represented without any large amount of variation in form or dimensions of specimens. But my observations induce me to believe that the southern forms, when taken on our shores, are generally dredged from water of considerable depth; whereas those of the arctic types are as invariably taken in shallow water.

The variations of depth and local habitats appear to us to depend more upon the condition of food and its general supply than upon other causes; we therefore think that the geographical distribution of animals in limited regions can only be worked out by a previous knowledge of the history of the animals, particularly in relation to their food, and even then cannot be very reliable.

Amongst the anomurous Crustacea I would wish to notice the genus that Leach has named *Munida* in order to distinguish it from the genus *Galathea*; but the points of distinction are not sufficient to warrant so great a separation, and they appear to me to be naturally but species of one genus.

Three fine specimens I have recently taken on the shelly ground off the Dudman, in about thirty fathoms of water. The first specimen that was obtained differed from those previously known and described by having, instead of a long central rostriform spine flanked by two shorter ones of analogous construction, three equally important anteriorly porrected spines—this in consequence of the two lateral spines being developed to a length corresponding with that of the central in normal specimens; whilst in another specimen the central spine appears to be rather longer in proportion to the lateral ones than that figured by either Leach or Prof. Bell, so that the specimen bears a very close relationship to *Galathea monodon* of Milne-Edwards from the Brazils—a circumstance that supports an opinion that I have elsewhere expressed, that there is a very considerable resemblance between the Crustacea of the South-American coast and that of the British seas.

This species, *Galathea bamffica* (*Munida Rondeletii*, Bell), is stated to be one of the rarest of our Crustacea, and is seldom to be met with in our museums. Its habitat is most probably

* Abstract, communicated by the author, from the Report of the Committee appointed to explore the Marine Fauna and Flora of the South Coast of Devon and Cornwall. (Brit. Association Report for 1867, p. 275.)

the temperate latitudes, in tolerably deep water, on the western shores of Europe; for although extending as far as the Shetlands, yet the specimens that have been dredged in the colder regions are, we believe, invariably very small, and the inhabitants of very deep water.

Among the *Galatheæ* that we have taken on our coast, and which embrace all that were previously known as British, is one that we think must be accepted as not having been previously described.

The largest specimen, measuring from the extremity of the tail to that of the extended hands, is little more than 2 inches, of which the animal itself, measuring from the extremity of the rostrum to that of the tail, is little more than 1 inch. This species differs from either of the others in having the large pair of chelate pereiopoda flat and broad, the fingers much curved, very distant, and meeting only at their apex when closed, furnished on the inside with a considerable brush of hairs, and armed near the base of the moveable finger with a prominent tubercle or tooth, but which appears to be of little importance, since it is not able to impinge against the opposite finger. I have sometimes thought that this specimen may only be an extreme form of the male of *Galathea squamifera*; but the armature of the surface of the hands, which is generally a safe guide in specific character, has a distinct variation. In *G. squamifera* the arms are covered generally with a series of curved scale-like tuberculations, the anterior margin of which is divided into a series of bead-like elevations, of which in the most typical parts, such as on the surface of the meros and carpus, the central prominence is elevated to a point; and the whole of the tubercular ridge is crowned by a row of short hairs, so minute that they are not perceptible except by the assistance of a lens. These tuberculations are closely packed and regular.

In the supposed new species the tuberculations are less prominent and defined, their margins can only be perceived to be at all baccated by careful arrangement of the light, while the cilia, being far less numerous, are yet more conspicuous under the lens. If it be only a variation of *G. squamifera*, as we are inclined still to consider it, it is too important a variety to be passed over without notice; and we have named it provisionally *Galathea digitidistans*, until the observation of a larger series of specimens than we have as yet seen may enable us to arrive at a correct conclusion.

The zoëa of the genus *Porcellana* has, I believe, been figured from exotic species by Dana*; and having the opportunity of

* [Also by Fritz Müller, 'Für Darwin,' p. 35, fig. 24.—Ed.]

observing that of *P. platycheles* (Pl. IX. fig. 4), I have taken advantage of the circumstance. It differs from the recognized typical zoëa of the common shore-crab (*Carcinus mænas*) in the monstrous development of an anterior and two posterior cornuous processes to the carapace, and in the formation of the telson; but in its complete character it offers an intermediate condition between the brachyurous and macrurous Crustacea. It has the appendages of the cephalon and pereion developed to a similar extent with those of the Brachyura, whereas the telson and carapace bear a nearer resemblance to the same parts in the Macrura, from which they differ in degree only. In the carapace, instead of the rostrum and the posterior angles of the carapace being only just pronounced as in the macrurous zoëa, they are developed to a larger extent in the anomurous larvæ, and in the young of the *Porcellanæ* to nearly twice or three times the length of the animal; while the telson, instead of being shaped like the caudal fin of a fish, has in the Anomura the central portion sometimes produced to an angle posteriorly.

Beyond this stage of the development of this species, or, I believe, any species of the Anomura, we have no sure knowledge, except that which I stated relative to the genus *Glaucothoë* being a stage in the development of the genus *Pagurus*.

The zoëa of *Pagurus* (Pl. IX. fig. 1) is probably tolerably well known to carcinologists, but I am not aware of its having been figured* or described. It has the anomurous character of a pointed rostrum and a projecting point at each of the posterior angles of the carapace, and the telson terminating in a gradually widening fishtail-like appendage, fringed with a few terminal spines—the appendages being developed rather on the type of those of the Brachyura than of the Macrura. During our expeditions we have taken specimens that we believe to be the zoëa of the same genus still further developed; we say believe to be, because it is only from analysis that we have come to this conclusion, and have not the testimony of direct observation that the one is the older stage of the other.

That which we take to be the second stage of the genus *Pagurus* (Pl. IX. fig. 2) was captured toward the end of May, in a towing-net, in Plymouth Sound. From its general appearance my first impression was that it was the young of a *Palæmon*; but closer observation and a careful dissection of its parts induced me strongly to believe that it is the young of one of the anomurous group of Crustacea,—in the first place, the form of the carapace; in the next, the general divergence of its appendages from and their resemblance to those of the zoëa of a macrurous Decapod. The superior

* [Likewise figured by Fritz Müller, *op. cit.* p. 36, fig. 26.—Ed.]

antenna is developed upon the brachyurous type; but the inferior has the squamiform appendage of the macrurous Crustacea. So have all the other appendages that pertain to the cephalon and pereion, except the last pair of pereiopoda; and these are not developed, at least they were not perceptible to our examination—a circumstance that would accord with the animal being an undeveloped anomurous crustacean. The pleon and its appendages bear a very close resemblance to those of the larva of a prawn, since it is equilaterally developed and furnished with a pair of appendages, posteriorly and ventrally, attached to each somite, the last of which is much larger than the others, and is evidently a progressive stage in the development of the great caudal plates of the macrurous Crustacea.

We attribute it to the genus *Pagurus* rather than to any of our other anomurous Crustacea, because it differs from the known zoëa of *Porcellana*, and of that of *Galathea* we have no knowledge; but from the nearer approach of these last genera to each other in their adult stage than to *Pagurus*, we are inclined to believe in a nearer resemblance of their larvæ. Hence our assumption that this present immature species is a young *Pagurus*.

The next stage to which we allude (Pl. IX. fig. 3) is one which we noticed in our preliminary Report to the British Association.

The animal is a small creature that was taken floating near the surface of the sea, in a warm day in June. Its general appearance is that of a young macrurous crustacean, and as such it has been classified near to *Callianassa* and *Calliadina*. It is symmetrical, except in the larger development of the great chela of the right side. The two succeeding pereiopoda are very long, but simple in their formation; the last two are considerably reduced in size, and the anterior terminates in a small imperfectly didactyle forceps,while the posterior has a copious terminal brush, consisting of cilia and short and broad spines, amongst which the short, obtuse, and spinous dactylos is discernible. The pleon is well developed, having each somite clearly defined, and all, except the first, carrying an equally developed pair of appendages, each of which consists of a peduncle and two unequal rami. The posterior pair, or uropoda, differ from the others in having the peduncle shorter and the outer ramus longer and more robust; it is likewise slightly curved, in the older specimens, more on the left side than on the right.

In this condition they probably continue until they find a suitable molluscous shell in which to reside. I imagine that

they may continue to cast their exuvium and grow, during the whole time that they are deficient of such shell, because I have taken specimens occupants of shells that are still smaller than the one described, and yet further advanced to maturity. It would be curious to see if, were they deprived entirely of the use of a shell for a habitat, they would continue to grow and retain the normal form of the pleon generally—a feature that characterizes some of the exotic closely allied genera.

Thus a careful examination of numerous specimens has enabled us to demonstrate the progressive development of the genus *Pagurus*, and to affirm with much confidence, judging by the descriptions and figures of the authors, that the genera *Glaucothoë* of M.-Edwards and *Prophylax* of Latreille are no other than an immature stage of the genus *Pagurus*; but since their specimens were exotic, they are probably the young of some foreign species.

Amongst the macrurous Crustacea we have had the opportunity of examining and figuring the larva of *Palinurus* (Pl. X. fig. 2). The young of this genus was first made known to the British Association by the late Mr. R. Q. Couch, of Penzance, at the Meeting at Dublin, in 1857, when he drew attention to the near resemblance existing between it and the genus *Phyllosoma*. In 1864–65, M. Gerbe, in the 'Comptes Rendus,' repeated the discovery of Mr. Couch, and asserts that the larva of *Palinurus* is identical with the genus *Phyllosoma*, and that consequently the genus *Phyllosoma* is the young of the genus *Palinurus*.

The larvæ of most of the Decapod Crustacea have the largest amount of development commencing with the cephalon and the pleon; whilst in the larva of *Palinurus* the greatest advancement exists in the anterior part of the cephalon and in the pereion, whereas the pleon is almost rudimentary.

On comparing it with the genus *Phyllosoma* (Pl. X. fig. 1), as M. Gerbe has done, there is little that can warrant a separation of the two in the general structure of the animals, or that might not be accounted for by increased development of the younger specimens. Yet there are certain points that weigh heavily in the balance of evidence against the larva of *Palinurus* and *Phyllosoma* being but different stages of the same animal.

(1) It is contrary to our experience that so small an amount of progressive development has taken place in an animal that has increased in growth to about thirty times its size. We generally perceive, in the development of Crustacea, that the most important changes are those that immediately succeed

the birth of the larva. (2) The most certain mark by which a young animal may be known is the immature condition of the antennæ, more especially the flagella; now, whilst in the larva of the *Palinurus* they are very rudimentary, in *Phyllosoma* they assume an adult character, and in the second pair one that is of a peculiar feature, at least in the species to which we refer. (3) The oral appendages appear to be present, though only as the germs of the future parts; whilst in *Phyllosoma* they appear to exist in a rudimentary condition that assimilates little to a progressive stage. (4) Double branchial vesicles are attached to the coxæ of each pair of pereiopoda, whilst none exist in the larva of *Palinurus*. We must admit, however, that this argument is not very strong, seeing that in the adult *Palinurus* such organs are present, and that there must be a period when they first appear; and it is most probable that their earliest stage is of the most simple character. And perhaps we should not have thought it sufficiently important to have remarked upon, had not M. Gerbe stated that *Phyllosoma*, like the larva of *Palinurus*, was without branchial appendages, and M. M.-Edwards remarked that these vesicular appendages are vestiges of the external branch of the limbs. (5) *Phyllosoma* is a tropical genus, and with such we can only compare the larva of *Palinurus*; two specimens only of the former have been obtained in the British seas, whereas *Palinurus* is very common on our coasts—an argument that might be very forcible were we not cognizant of the fact that we are quite as much, if not more, in the dark in relation to the development of the common lobster.

Our ignorance upon these interesting and important points in the history of the Crustacea, together with the discovery of Fritz Müller that the larva of *Peneus*, and probably that of some other prawns, very closely resembles that of the cirripeds and other entomostracous larvæ, shows that there is much yet to be done of far more interest to zoological science than the mere discovery of new species to be added to our fauna. The great diversity of structure, and the wonderful variation in the development of animals that possess a great similarity in their adult condition, indicates that careful study of these animals will probably assist in throwing a considerable light on some of the more profound problems of biological knowledge.

Several specimens of *Scyllarus arctus* have been taken recently on our coasts. It is some years since Mr. Couch announced the first appearance of this as a British species; and none has since been recorded until these last two years, when six have been taken near Penzance by Mr. Cornish, and one off the Mewstone, near the eastern entrance of Plymouth Sound; two

of these were furnished with spawn, and two of the others were found in the stomach of a codfish. That which was obtained off the Mewstone was 4½ inches long, and one of the most interesting additions to our local fauna: this length is half as long again as that recorded by M. Milne-Edwards of the Mediterranean specimens.

In the dredging-list published by the British Association, the common lobster of Europe is called *Astacus gammarus* (L.), *marinus* (Fabr.), and *Homarus vulgaris* (M.-Edwards). But, since the descriptions of Crustacea by Linnæus are so very general, and the specific name used by him has been long closely associated with that of a very distinct genus, we think that of Fabricius, the next in succession, should be adopted. Again, the generic name, given by Fabricius, of *Astacus*, although prior to all others, yet included the freshwater genus, with which it is so closely associated as to make an exchange inconvenient. I therefore propose, in accordance with the rules laid down by the Association, to retain the generic name of M. M.-Edwards and the specific name of Fabricius, and call it *Homarus marinus*, Fabr.

We cannot turn away from this species without noticing the manner in which the process of repair is carried on in the development of a new flagellum to the inferior pair of antennæ. Mr. Lloyd, Conservator of the Marine Zoological Collection at Hamburg, to whom we are indebted for the preparation from which fig. 4 in Pl. XI. is taken, writes to me:—"The animal lost the antenna by accident, just where the juncture with the peduncle takes place, and then the antenna began to grow in a spiral case, the spiral growing larger and increasing the number of its turns as it grew older, but never getting hard or coloured. When the entire exuviation of the lobster took place (in about four months after the antenna was broken off), the antenna was drawn out of its special case and came forth straight, the spiral skin retaining its shape. Hardening of the antenna does not take place (or at least it does not appear hard) till after exuviation, and in like manner the limbs of all the lobsters here which renew their limbs."

A specimen of the genus *Axius* was taken by Mr. Couch off Polperro, and described by him as new, in the 'Zoologist,' 1856, pp. 52–82; but I am not aware that it has been since met with.

I have taken what I believe to be specimens of *Crangon fasciatus* and *Cr. sculptus*; and a careful comparison of them with the descriptions and figures of the authors has failed to convince me that they are not more or less spinous varieties of the same species; and in character they agree so well

with the description of *Crangon boreas* that it is difficult to believe that they are not depauperized specimens of that large arctic species.

Several specimens of *Alpheus ruber* have been taken on shelly ground off the Dudman,—and from the same locality two other specimens of *A. Edwardsii*, which I believe is the first time that this latter species has been recorded as British. I had them alive for several days. Their colour is a brilliant red crimson, *A. ruber* being rather paler and more banded than *A. Edwardsii*. One peculiar and interesting feature in the structure of this animal is the alteration of the character of that portion of the carapace that covers and protects the organs of vision (not so much from the anterior development of the carapace as from the eyes having receded beneath it), which, while it offers protection to the organs of vision, yet has become so transparent that it is only by close and careful examination that, in the living state, the relation of the two parts to each other can be distinguished.

The next genus to which we have to allude is one that we believe must be described as new to our fauna. It was first described by Costa from a Mediterranean species (*Typton spongicola*), as far back as 1844, in the 'Annali dell' Accad. degli Aspir. Nat. di Nap.' ii., also by Grube (Ein Ausflug nach Triest und Quarnero, pp. 65 & 125), and again by Heller under the name of *Pontonella* (Verhandlungen des zool.-bot. Vereins in Wien, p. 627, Tafel ix. f. 1–15), as well as in his 'Crustaceen des südlichen Europa,' p. pl. f. . Believing it to be distinct, I have given it the name of *Typton spongiosus*, of which the following is a short description :—

Gen. char.—Carapace short and deep, covering the entire pereion. Pleon twice as long as the carapace, with the lateral walls deep. Eyes prominent, not concealed under the carapace; superior antennæ having a secondary branch. First pair of pereiopoda equal, slender, long, and chelate; second pair large, in general the right much larger than the left.

Spec. char.—Carapace having a short simple rostrum. Eye longer than the rostrum. Anterior antennæ with the secondary appendage longer than the primary; posterior antennæ having the squamiform plate of the third joint small, pointed, and not ciliated. Second pair of pereiopoda having the propodos as as long and nearly as broad as the carapace. Dactylos of the right hand with the cutting margin convex and simple, of the left hand less convex and cuneated. Posterior pair of pleopoda with the posterior external angle of the outer ramus dentated, the inner tooth being the longest; telson armed with

four lateral dorsal spines, and tipped with a few spines and hairs.

We have taken several specimens of *Nika*; and from their general resemblance to *N. Couchii*, while possessing the channelled telson of *N. edulis*, so particularly pointed out by Bell as specifically distinctive, I am much inclined to believe that there is but a single British species yet known, and that *N. Couchii* is but a variety of *N. edulis*, Risso. An examination of its parts in detail has shown us that the mandibula (Pl. XI. fig. 3) are formed on a plan that nearer associates the genus with *Crangon* than with *Alpheus*, in the family of which (Alpheidæ), the latter being the type, *Nika* is placed by Milne-Edwards and Bell, while Dana, more correctly we think, has placed it in a subfamily of the Crangonidæ, the Lysmatinæ.

Two or three specimens of *Athanas nitescens* have been taken off Polperro.

Hippolyte Barleei, which was described by me from a Shetland specimen several years ago, must, I think, be expunged from the list of species, since, as pointed out by the Rev. A. M. Norman some time since, it is only an accidental variety of *H. Cranchii*. Observations of the Stomapoda on the south-western coast have been limited to a few of the commoner species: whether this arises from the species not being abundant on our southern shores as compared with those on the northern, or from accidental causes attributable to collecting arrangements, is yet to be determined.

Amongst the smaller Crustacea, there is little to which I should wish to draw special attention, except the recent discovery of what may prove to be an undescribed *Anthura*, and some observations on the structure of *Tanais*.

In 1861 Van Beneden asserted that the proper place of the genus *Tanais* was near to that of the family of the Diastylidæ, because the cephalon was developed upon the type of the carapace of the Decapoda. In 1864 this opinion was followed by Dr. Fritz Müller, who stated that though he had been unable to identify branchial appendages, yet he felt assured that it possessed rudimentary organs, because he had observed a current of water playing from beneath the carapace. Recently, having obtained some living specimens, I have been able to support Dr. Fritz Müller's conclusion relative to the current of water; for, by the assistance of transmitted light, I have been able, through the walls of the carapace, to see the branchial appendage waving to and fro; since which I have dissected out the organ, a drawing of which accompanies this memoir. (Pl. XI. fig. 5.)

EXPLANATION OF THE PLATES.

PLATE IX.

Fig. 1. First stage of development of *Pagurus**.

Fig. 2. Second stage. The author gives this with the reservation stated, having taken it swimming in the open sea. c, dorsal view of cephalon; *a*, eye; *b*, superior antennæ; *c*, inf. ant.; *d*, mandible; *g*, posterior maxilliped; *h*, first pair of gnathopoda; *l*, second pair; *k*, first pair of pereiopoda; *l*, *m*, *n*, *o*, three posterior pairs of pleopoda; *p*, *q*, *t*, pleopoda; *u*, sixth pair of pleopoda; z, telson.

Fig. 3. Third stage, representing the genus *Glaucothoë* of Milne-Edwards and *Prophylax* of Latreille: *n*, penultimate pair of pereiopoda; *o*, ultimate pair of pereiopoda; *p*, a pleopod; *u*, sixth or posterior pair of pleopoda; z, telson; p, pleon of an older specimen.

Fig. 4. Zoëa of *Porcellana platycheles*: z, telson.

PLATE X.

Fig. 1. *Phyllosoma.*

Fig. 2. Zoëa of *Palinurus marinus.*

PLATE XI.

Fig. 1. *Typton spongiosus*, n. sp. References as above.

Fig. 2. *Alpheus Edwardsii.*

Fig. 3. Mandible of *Nika edulis.*

Fig. 4. *Homarus marinus.* Development of flagellum to lower antenna.

Fig. 5. *Tanais*: *h*, first pair of gnathopoda, with branchial appendage attached.

XI.—*Observations on some of the* Heliotropieæ.

By JOHN MIERS, F.R.S., F.L.S., &c.

IN the 'Prodromus' of De Candolle we find the order *Borragineæ* divided into four distinct tribes, the *Cordieæ*, *Ehretieæ*, *Heliotropieæ*, and *Borrageæ*. Long before the appearance of that work, the late Mr. R. Brown had pointed out, in his 'Prodromus,' p. 492, that the *Cordieæ* ought to be held as a distinct family, on account of their 4-fid style, and their seeds without albumen, with plicated cotyledons—an opinion supported by Endlicher and Lindley for reasons which appear sufficiently valid. Von Martius rightly held that the perfectly gynobasic style, placed in the middle of four distinct ovaries, entitled the *Borrageæ* to rank as a separate natural order, and accordingly he combined the two remaining tribes of DeCandolle, the *Ehretieæ* and *Heliotropieæ*, in another family, which he designated with the name of *Ehretiaceæ*. The uncertainty and confusion in the distribution of the species in these several groups have in great measure arisen from a neglect to examine the structure of the fruits; it may, however, be taken as a rule that among the whole of them it is essential that the seeds

* This was taken so young from the ovum that I am not certain whether the long projecting rostrum is a feature or not, as at this period it is generally folded under.

should be suspended and solitary in their respective cells, with a superior radicle. But it is important to notice that Gaertner distinctly attributes to *Beurreria*, and figures, a 4-carpellary fruit, with seeds having an inferior radicle; and Kunth describes his South-American species of *Ehretia* (formed into the genus *Amerina* by De Candolle) as having a unilocular ovary, with four ovules attached to two bifid opposite parietal placentæ—structures only reconcileable with *Verbenaceæ*: indeed De Candolle appeared so far disposed to adopt this view that he suggested the latter genus might be allied to *Tectona*. *Amerina*, however, appears much nearer *Citharexylon*, with which it agrees in its tubular persistent calyx, its cylindrical 5-lobed corolla, with five exserted stamens, the ovary and seed being formed as above indicated, having also an arborescent habit with opposite leaves. The doubts that have been thrown upon the truth of Kunth's observations concerning *Amerina* and of Gaertner's regarding *Beurreria* are only inferences founded upon analogy; but no one has yet shown by actual examination that the statements of those botanists are contrary to fact.

It is difficult to draw a line of distinctive characters between the *Ehretieæ* and *Heliotropieæ*: some have suggested a suffruticose habit in the former, and a subherbaceous one in the latter; but these characters are too variable to be of use: others have urged the presence of albumen and a bifid style in the former, and the want of albumen with an undivided stigma in the latter; but the former character has been denied to *Ehretieæ* by De Candolle, and I have to show the existence of a deeply cleft stigma in *Heliotropieæ*. De Candolle places *Tournefortia* in *Ehretieæ*; Fresenius, who has elaborated the Brazilian *Borragineæ*, ranks that genus in *Heliotropieæ*, and with reason. To the latter tribe, again, has been assigned the distinctive character of a scorpioid spicated inflorescence; but that character is rendered nugatory by the presence of solitary axillary flowers in *Coldenia* and in many species of *Schleidenia*, and of several congested single axillary flowers in *Tiquilia*. There remains, therefore, scarcely a tangible uniform character that can mark the limit between *Ehretieæ* and *Heliotropieæ*.

In regard to *Ehretia* I will not venture to offer any decided opinion, because I have had no opportunity of examining its species; but we are evidently much in the dark concerning its real structure. All authors agree in attributing to *Ehretia* a 4-locular ovary with a slender simply 2-fid style, a single ovule suspended from the summit of each cell, and a baccate fruit enclosing a 4-celled nut, or two nucules, each 2-celled. But Dr. Wight, in his 'Icones,' pls. 1382 & 1383, figures in *Ehretia* a bifid style upon an ovary which is 1-locular, with

two opposite bipartite parietal placentæ, each fork bearing a single ovule, as in *Ægiphila* and *Amerina*. If these figures be correct, as there is no reason to doubt, these species cannot belong to *Ehretia*, or else the characters of the genus have been erroneously defined, and the tribe itself has been placed in a wrong family. These discrepancies show that we have yet much to learn in regard to the *Ehretieæ*. If we hold *Beurreria* still in doubt, as well as *Amerina*, for the reasons before given, there will remain only *Ehretia* itself to represent the tribe; and this offers so many anomalous characters that DeCandolle considered it must ultimately be divided into several genera, of which he traced the outlines in *Beurreria*, *Carmona*, *Xerodema*, and *Menais*. *Xerodema* has been shown to be identical with *Rhabdia*, a Brazilian genus minutely and accurately described by Prof. von Martius in his 'Nova Genera,' and since figured by Sir Wm. Hooker (Icon. 823). This construction, of a 1-locular ovary, with two opposite 2-lamellar placentæ bearing an ovule on each of their reflected margins, and a fruit with four nucules, each with a longitudinal open slit leading into two cells, is quite at variance with the structure that has been attributed to *Ehretia* and its allied genera. I will offer some observations upon *Rhabdia* and *Cortesia* under separate notices.

The following is a synopsis of the genera of the *Heliotropieæ*:—

1. Fructus baccatus; albumen distinctum.
 A. Pyrenæ 2, singulæ 2-loculares.
 a. Embryo rectus; stamina inclusa; stylus brevis; stigma latum, breviter 2-lobum *Tournefortia.*
 B. Pyrenæ 4, singulæ 1-loculares.
 b. Embryo lunatim curvatus; corollæ laciniæ subulatæ; stamina inclusa; stylus longiusculus; stigma majusculum, apice conico, piloso *Messerschmidtia.*
2. Fructus exsuccus; albumen distinctum, aut nullum.
 C. Pyrenæ 2, singulæ 2-loculares; stamina inclusa.
 c. Stigma breve, vix divisum; albumen nullum.... *Heliophytum.*
 d. Stigma magnum, elongatum, profunde 2-fissum; albumen distinctum..... *Cochranea.*
 D. Pyrenæ 2, singulæ 2-loculares.
 e. Stamina longe exserta; stylus tenuis; stigma tenuiter 2-fidum *Tiquilia.*
 E. Pyrenæ 4, singulæ 1-loculares.
 f. Antheræ apice papilloso cohærentes; stylus brevis aut subnullus; stigma magnum; flores interdum solitarii et axillares *Schleidenia.*
 g. Antheræ glabræ, oblongæ, liberæ; stylus mediocris; stigma magnum; flores in spicas longas curvatas terminales, 1-laterales *Heliotropium.*
 h. Antheræ glabræ, globosæ, liberæ; stylus simplex, 2-fidus; flores axillares, solitarii *Coldenia.*

Pentacarya, Hook. & Arn., and *Euploca*, Nutt., appear to be foreign to this group. *Piptoclaina*, Don, differs little from *Heliotropium*, except in its four broadly margined 1-celled nuts, frequently reduced to two by abortion; it has five distinct sepals (not a tubular 5-toothed calyx, as Don states); it has the habit of *Coldenia*, but with terminal solitary spikes. *Halgarnia*, Gaud., also appears alien to this group, because of its campanular calyx and its incompletely 2-celled ovary with two pairs of collateral ovules suspended from two semiseptiform placentæ. As the genera *Cochranea* and *Messerschmidtia* hitherto appear almost unknown, I will here define them and note their species.

Cochranea.

This genus, proposed by me in 1825, upon a Chilian plant, was afterwards described as a variety of the *Heliophytum stenophyllum*, Hook. & Arn. It differs from *Heliophytum* in the peculiar habit of the plants (being short, erect, branching shrubs); they have more woody (not fistulose) branches, which are generally covered with numerous very fasciculated linear leaves; the genus also is remarkable for its very large elongated stigma, two or three times the length of the style, or even longer, having a broad annular peltate enlargement at its base, and cleft at the summit, generally halfway down, into two narrow subulate segments, which are entire, or more rarely 2-denticulated. The fruit consists of two bilocular nucules, as in *Heliophytum*; but they have not the same deep vacuities on the inner face, and the seeds are enveloped in a distinct albumen. The inflorescence is not in long, solitary or geminate spikes, as in *Heliophytum*, but is corymbosely branched, at first in subglobose heads, afterwards becoming more spread.

Cochranea, nob.;—*Heliotropium* et *Heliophytum* in parte auct.—*Sepala* 5, lanceolata, erecta, plus minusve pilosa, æstivatione imbricata, persistentia. *Corolla* hypocrateriformis, *tubo* cylindrico vel supra medium paulo infundibuliformi, fauce plicis 5 angustato, sub-5-gono, nervis 5 crassis a medio loborum in angulis tubi decurrentibus et intra faucem sæpe glandulis totidem munitis, *limbo* expanso, vix ad medium 5-lobato, lobis rotundatis cum plicis totidem alternantibus, æstivatione valde imbricatis. *Stamina* 5, inclusa, fere sessilia, tubi dimidia longitudine: *filamenta* brevissima, circa medium tubi affixa; *antheræ* lanceolatæ, 2-lobæ, mucronatæ, imo breviter auriculatæ, in sinu dorsaliter affixæ, erectæ, utrinque rima laterali dehiscentes. *Discus* parvus, hypogynus, margine crenulatus. *Ovarium* in hoc impositum,

subglobosum, 4-sulcatum, 4-loculare, loculis *ovulo* solitario suspenso munitis: *stylus* teres, superne paulo incrassatus; *stigma* inclusum, valde elongatum, imo annulo crasso cinctum, sursum attenuatum, plus minusve profunde 2-fissum, laciniis subulatis, integris, vel 2-denticulatis. *Fructus* exsuccus, globosus, profunde 2-sulcatus, calyce persistente inclusus; *nuculæ* 2, semiglobosæ, marginibus rotundatis, facie subplana, foraminulo obsoleto incavatæ, osseæ, singulæ 2-loculares, loculis 1-spermis. *Semen* ovatum, apice suspensum; *integumenta* tenuissima; *albumen* parcum, carnosum; *embryo* orthotropus, *cotyledonibus* ovatis, subcompressis, carnosulis, *radicula* tereti ad summum spectante duplo longioribus.

Suffrutices *Chilenses, dumosi, odore balsamico scatentes, ramosi;* ramis *sæpe virgatis, valde foliosis;* folia *in axillis alternis plurima, fasciculata, sæpius anguste lineares, marginibus interdum valde revolutis:* panicula *terminalis, primum subcapitata, demum expansa, valde ramosa, ramis breviter divisis et spicatifloris;* flores *parvi,* 1-*laterales, sessiles, ebracteati.*

1. *Cochranea conferta*, nob. Trav. Chile, ii. 529;—Heliophytum stenophyllum, var. rosmarinifolium, *DC. Prodr.* ix. 552; *Gay, Chile*, iv. 456;—ramis strictiusculis, erectis, breviter pauciramulosis, in junioribus viscoso-pilosulis, demum glabris, confertissime imbricatim foliosis; foliis in axillis alternis, plurimis et fasciculatis, anguste linearibus, imo spathulatis, sessilibus, marginibus valde revolutis, supra subrugulosis, glabris aut obsolete puberulis, subtus parce rigido-pilosis: paniculis terminalibus, corymbosis; ramis alternis 3–4, spicas plurimas alternas gerentibus; floribus sessilibus, uniserialibus; stigmate stylo 2-plo longiore, fere ad medium 2-fido, laciniis subulatis, obtusulis.—In Chile: *v. v.* ad Cuesta larga de Llaillay; *v. s. in herb. variis* (Cuming, 377; Bridges, 235); *in herb. Hook.*, Coquimbo (Harvey), ex Mus. Paris. Chile (Gay).

I found this plant in 1822 in the province of Quillota, where it is frequent upon the lofty hills, forming a bushy shrub from 3 to 5 feet in height. Its erect branches are densely covered with crowded, imbricated leaves, fasciculated in the approximated axils; they are 14–18 lines long, $\frac{1}{2}$ line broad. The terminal inflorescence, when fully developed, has a main peduncle $1\frac{1}{2}$–2 inches long, bractless, expanding into three or four alternate branchlets, 9 lines long, bearing many crowded sessile flowers arranged unilaterally in a spike; the sepals are $1\frac{1}{4}$ line long, obtusely subulate, glabrous, with ciliated mar-

gins; the tube of the corolla is 2 lines long, glabrous, with five glands in its mouth; the border is $2\frac{1}{2}$ lines in diameter, white, with red nervures, becoming pink when faded; the stamens, half the length of the tube, reach its mouth; the ovary is 4-grooved, seated on a crenulated disk; the style is about the same length; the stigma, double that length, is annulated at its base, conical, and simply 2-fid to nearly its middle*.

Var. *auriculata*;—caulibus erectis, rugosis; foliis creberrime divaricatis, imbricatim tectis; ramulis paucis, fuscis, granulato-papillosis; foliis in axillis approximatis circiter 10, longe linearibus, sessilibus, imo latioribus et subauriculatis, marginibus subsinuatis, subrevolutis, supra glabris: paniculis terminalibus, corymbosis; stigmate stylo æquilongo, apice 3-dentato.—In Chile: *v. s. in herb. Hook.* (Lobb, 442).

A plant with the habit of *C. congesta*, differing in its more crowded, more divaricated, longer leaves. It is probably a distinct species intermediate between *C. congesta* and *C. sinuata*, differing extremely from the latter in its habit, its longer, narrower, and more crowded leaves. The leaves (generally eight or ten in each approximated axil) are $1\frac{1}{2}$–2 inches long, 1 line broad, quite glabrous above, with subsinuated margins, are minutely puberulous or pulverulent below, when examined under a strong lens; the peduncle and its branches are pubescent; the acute-lanceolate sepals are pilose on both sides; the cylindrical tube of the corolla is angular and pilose; the stigma (rather longer than the style) is somewhat conical, and 3-denticulated at its apex. In Bridges's No. 1838, referred by De Candolle to *H. myosotifolia*, where I have placed it, the stigma is invariably as I have there described it; but here it is constantly 3-lobed or imperfectly 4-denticulate, as De Candolle mentions. There is probably some confusion in the specimens.

2. *Cochranea corymbosa*, n. sp.;—valde ramosa; ramis brunneis, rugosis; ramulis longis, adscendentibus, subflexuosis, epidermide rubente laxa rimosa nitente vestitis; foliis majoribus fasciculatis, late lanceolatis, acumine brevi obtusulo, in petiolum longum imo dilatatum sensim cuneatis, planis, submembranaceis, tenuissime nervosis, utrinque subglabris, rugulosis, versus marginem et in costa subscabrido-pilosis: paniculis in ramulis terminalibus, corymbosis, glabris; pedunculo longissimo, compresso, rubente, nitido, superne alternatim et subremote ramoso; ramulis apice bis

* A drawing of this plant, with ample analytical details, will be shown in Plate 53 A, in the second volume of my 'Contributions.'

dichotome divisis, ultimis tenerrimis, unilateraliter spicatifloris; floribus majusculis, inferioribus breviter pedicellatis, reliquis sessilibus; sepalis lanceolatis; stigmate stylo æquilongo, conico, fere ad basin 2-fisso, laciniis subulatis, obtusulis.—In Chile: *v. s. in herb. Mus. Brit. et Hook.*, Coquimbo (Bridges, 1341).

This species is at once distinguished from all the others by its much larger, flat, submembranaceous leaves. It seems to be a low-growing shrub with ascending branches, with branchlets 3–4 lines apart, which are subangular, subcompressed, 4–6 inches long, with axils 4–6 lines apart, which are somewhat nodose; the leaves (including the petiole, 7 lines long and ½ line broad) are 2 inches long, 3–3½ lines broad, the narrow petiole being somewhat enlarged at its insertion upon the node; within this, three or four shorter leaves are fasciculated in each axil; they are all nearly glabrous. The terminal peduncle is 4 inches long, bearing at intervals of 3 to 9 lines several branches 6–12 lines long, each divided into two unilateral spikes 1½ inch long, bearing sessile flowers 2 lines apart; the sepals, almost glabrous outside, are pubescent within and on the margins, are 2 lines long, acutely lanceolate; the tube of the corolla is 3 lines long, ½ line broad, with a border 5 lines in diameter; the anthers, 1 line long, are inserted 1¼ line above the base; the pistil is the length of the sepals, the style being rather longer than the stigma, and twice the length of the ovary.

3. *Cochranea sinuata*, n. sp.;—subdichotome et tortuose ramosissima, ramis ramulisque glabris, epidermide laxa fusca rimosa vestitis, junioribus pilosulis; foliis in axillis plurimis, fasciculatis, linearibus, apice rotundatis, imo in petiolum angustum longe spathulatis, marginibus undulato-sinuatis, sæpe subrevolutis, submembranaceis, supra rugulosis, in nervis impresso-sulcatis, obsolete pilosis, subtus pallidioribus, plus minusve cano-pilosis: paniculis terminalibus, subcorymbosis, alternatim ramosis, ramis geminatim divisis et spicatifloris; stigmate stylo paulo longiore, imo annulato, conico, granulatim viscoso, ad medium 2-fisso, laciniis 2-denticulatis.—In Chile: *v. s. in herb. Mus. Brit.*, Coquimbo (Bridges, sine num°.); *in herb. Hook.*, Coquimbo (Bridges, 1342).

This is evidently a low-growing shrub, with erect branches, which, in the lower portions, are nearly bare of leaves, very rough, with tortuous branchlets again divided, the younger ones being 5 or 6 inches long. The leaves are 9–14 lines long

(including a petiole of 3 lines), 1½–2 lines broad, with very sinuous and undulated margins. The many approximated floriferous branchlets form a large corymbose head: each terminal panicle has a peduncle 4 lines long, with four alternate branches 3–4 lines apart, 4 lines long, each divided into two spikes 1½ inch long; the sepals are 1 line long, oblong, obtuse, pilose outside; the tube of the corolla is 1½ line long, with a border 4 lines in diameter; the pistil is 1 line long, the stigma being a little longer than the style.

4. *Cochranea stenophylla*;—Heliophytum (Heliotropium) stenophyllum, *Hook. & Arn. Beech. Voy.* 66; *DC. Prodr.* ix. 552; *Gay, Chile*, iv. 456;—caulibus erectis, longiusculis, vix flexuosis, subnudis, nodis prominulis ruderatis, superne valde ramosis, ramulis plurimis, alternatim approximatis, divaricatis, griseis, glabris, paucifoliosis et puberulis; foliis fasciculatis vel rarius solitariis, linearibus, utrinque attenuatis, crassiusculis, supra breviter sparsim tuberculato-pilosis, subtus adpresse hirtulis: paniculis terminalibus, subcorymbosis, pilosis; pedunculo ramos 3–4 alternos breves spicatifloros gerente; floribus majusculis, crebriter sessilibus; stigmate stylo æquilongo, imo incrassato, conico, fere ad basin 2-fido, laciniis 2-dentatis.—In Chile: *v. s. in herb. Mus. Brit. et Hook.*, Coquimbo (Bridges, 1340).

These specimens have a somewhat flexuous knotty stem, 1 foot long, above which they throw out several close ascending branches, 4–10 inches long, with several divaricating branchlets, at distances of 6–9 lines, and about 4 inches long. The leaves are 5 lines long, ¾ line broad; the terminal peduncle, 6–9 lines long, bears three alternate short curving spikes, each with about six flowers, all forming a corymbulose head; the sepals, 1¾ line long, ½ line broad, are linear, pilose on both sides; the tube of the corolla is 2 lines long, a little swollen in the mouth, pilose on its angles, with a border 4 lines in diameter; the pistil is 1½ line long, the stigma as long as the style, cleft for nearly half its length into two obtuse segments, which are minutely 2-denticulated at their apex.

The original typical specimen is not to be found in the Hookerian herbarium.

5. *Cochranea myosotifolia*;—Heliophytum stenophyllum, var. myosotifolium, *A. DC. Prodr.* ix. 552; *Gay, Chile*, iv. 456;—ramosum, ramis subtortuosis, irregulariter diffusis, crebre nodosis, epidermide rimoso, griseo; ramulis teretibus, griseo-puberulis; foliis in axillis alternis, plurimis, fasciculatis, linearibus, imo paulo attenuatis, apice obtusulis, utrinque

adpresse scabrido-pilosis, marginibus subrevolutis; inflorescentia terminali, pubescente; pedunculo 2-fido, in ramos dichotome spicatifloros diviso; floribus crebriter sessilibus; stigmate stylo brevissimo 8-plo longiore, imo incrassato, sursum acutissime conico, ad medium 2-fisso, laciniis subsetaceis.—In Chile: *v. s. in herb. Mus. Brit.*, Coquimbo (Bridges, 1338).

This appears to be a low straggling shrub, with irregularly spreading branches covered with a glabrous splitting epidermis; the lower ones are knotty, with prominent leafless nodes; the upper branches are terete and pubescent, with axils 2–6 lines apart. The leaves are 8 lines long, 1 line broad; the peduncle of the terminal inflorescence is 9 lines long, its branches 3–4 lines long, each bearing two short spikes, all forming a corymbose head; the sepals are 2 lines long, acutely linear, pilose on both sides; the tube of the corolla is $1\frac{3}{4}$ line long, somewhat larger about the mouth, and pilose outside, with a border $3\frac{1}{2}$ lines in diameter, with five radiating, broad, coloured nervures; anthers 1 line long, reaching the mouth; pistil $1\frac{1}{2}$ line long, the ovary, style, and stigma being in the proportions of 3 : 1 : 8.

6. *Cochranea florida*;—Heliophytum floridum, *A. DC. Prodr.* ix. 553;—Heliotropium floridum, *Gay, Chile*, iv. 457;—e basi ramosissima, ramis subangulatis, ramulisque crebris, rufescentibus, glabris; foliis linearibus, obtusis, imo angustissime spathulatis, planis aut marginibus vix revolutis, utrinque subrugulosis, fere glabris aut versus margines obsolete pilosis: paniculis terminalibus, corymbosis, 1–3-ramosis, ramis spicatifloris; floribus sessilibus, majusculis; stigmate stylo fere æquilongo, imo annulato, apice 2-fisso, laciniis 2-dentatis.—In Chile: *v.s. in herb. Hook.*, Coquimbo (Cuming, 858; Bridges, sine num°.); ex Mus. Paris. (Gay).

A low-growing shrub, with suberect or decumbent stems, with ascending, very approximated branches, covered with a lax, reddish, shining epidermis; leaves 8–10 lines long, $1–1\frac{1}{2}$ line broad, decurrent on a petiole of one-fourth their length; peduncle of terminal inflorescence 1 inch long; its branches, 3 or 4 lines apart, are bare at base, spicated unilaterally, with few sessile flowers; the acutely lanceolate sepals, pilose on both sides, are $2\frac{1}{2}$ lines long; the tube of the corolla is pentagonous, glabrous, 3 lines long, the expanded border 5 lines in diameter; the stamens occupy the upper half of the tube; the pistil is $2\frac{1}{2}$ lines long; the conical stigma, annular at base, is cleft for one-third or one-fourth of its length into two segments,

2-denticulate at their apex. In Bridges's specimen the flowers are paler and smaller, and the leaves narrower.

7. *Cochranea hebecula*, n. sp.;—ramosissima, ramis griseis, creberrime ramulosis, ramulis junioribus dense sericeo-pubescentibus, incanis; foliis fasciculatis, oblongo-linearibus, imo in petiolum angustissime spathulatis, apice rotundatis aut obtuse attenuatis, carnosulis, subplanis, utrinque incano-pilosulis, eveniis: paniculis corymbosis, terminalibus, 2–3-spicatis; floribus majusculis, 1-serialibus; stigmate stylo 6-plo longiore, 2-fido, laciniis 2-denticulatis.—In Chile: *v. s. in herb. Mus. Brit.*, Coquimbo (Bridges, sine num°.).

This appears to be a bushy plant, with knotted branches 3 lines thick, divided at their summit into numerous very close leaf-bearing ramifications, 8–10 inches long, with branchlets 4–6 inches long; the axils are 3–6 lines apart; the leaves 8–12 lines long, 1 line broad; the terminal peduncle is 6 lines long, sometimes bearing a single spike, 2 inches long, or with two or three alternate spicated branches 3–4 lines apart, much shorter, bearing a few large flowers 1 line apart; calyx 1 line long, cleft nearly to the base, where it is shortly cupuliform, with five acutely oblong segments, densely pilose on both sides; the tube of the corolla $1\frac{1}{4}$ line long, 5-gonous, somewhat pilose outside, with a border 4 lines in diameter; pistil somewhat longer than calyx; stigma annular at base, six times as long as the style, cleft for one-third of its length into two broadish bidenticulate segments.

8. *Cochranea ericoidea*, n. sp.;—ramosissima, ramis ramulisque tenuissimis, divergentibus, pallidis, glaberrimis aut molliter puberulis, axillis cupula brevissima obtusa prominula foliigera munitis; foliis pluribus, fasciculatis, parvis, linearibus, sessilibus, apice callosis, carnosulis, enerviis, supra pilis rigidulis, imo tuberculatis scabridulis, subtus costa et marginibus subrevolutis scabridule hirtellis: paniculis terminalibus, pilosis, sæpius geminatim spicatifloris; floribus sessilibus, minoribus; stigmate longissimo, incluso, 2-fido, laciniis obtusis.—In Chile: *v. s. in herb. Mus. Brit. et Hook.*, Coquimbo (Bridges, 1339).

This appears to be a low straggling shrub, with very slender divaricating branches, having much the habit of an *Aloysia*; the lower branches are quite smooth and bare; the foliiferous branchlets are very slender, scarcely more than $\frac{1}{4}$ line in thickness, nodose at the axils, with a very short obtuse spine, produced by the persistent base of the midrib of the exterior leaf: out of these cupular nodes, which are 2–3 lines apart,

three or four leaves spring, which are 3–5 lines long: the peduncle is 2–3 lines long, with geminate or three alternate spikes 3 lines apart, 1–1½ inch long, rigidly and shortly pilose; the sessile flowers are 1–2 lines apart; the sepals, ¾ line long, are connate at base into a short cup, with oblong segments, callous at the apex, fleshy, pale green, pilose on both sides; tube of corolla 1 line long, wider and pilose above, with a border 2 lines in diameter; pistil the length of tube of corolla, with a subglobose sulcated ovary seated on a 10-lobed disk; the stigma, annular at base and as broad as the ovary, six times as long as the style, tapering to an obtuse point, cleft for a quarter of its length into two obtuse segments.

9. *Cochranea filifolia*, n. sp.;—ramosissima, ramis teretibus, nodosis, epidermide grisea rugulosa tectis, striatellis; ramulis alternatim approximatis, subadscendentibus, glabris, junioribus papilloso-tomentosis; foliis in axillis, plurimis, inæqualibus, fasciculatis, rarius solitariis, spathulato-linearibus, parvis, crassiusculis, granuloso-rugosis, divergentibus: paniculis floribundis, in ramulis terminalibus, glanduloso-puberulis; pedunculo bis dichotome diviso, ramis ultimis tenuibus, spicatifloris; floribus sub-2-seriatis, remotiusculis, sessilibus; sepalis brevibus, extus farinaceo-leprosis; stigmate imo lato, conico, profunde 2-fido, laciniis obtuse 2-dentatis.—In Chile: *v. s. in herb. Mus. Brit. et Hook.*, Coquimbo (Bridges, 1343).

These specimens of Bridges's collection, though under the same number as *C. chenopodiacea* in M. de Boissier's herbarium, are specifically very distinct from it. The plant is everywhere covered with a resin-like minute granulation; the leaves are more than twice the length and narrower than those in the species referred to: it is somewhat ericoid in its habit, with the young branchlets terete, fulvous, and rugulose, 6–8 inches long, with axils 3–4 lines apart. The leaves are 3–6 lines long, ½ line broad. The peduncle of the terminal inflorescence is ¾–1 inch long, twice dichotomous, the ultimate branches spicated, 2 inches long, with about eight rather large sessile flowers, 3–4 lines apart, all forming a corymbose panicle; the sepals are ¾ line long, obovate, obtuse, erect, fleshy, covered with whitish leprous scales, glabrous within; the tube of the corolla is cylindrical, 1 line long, the border being 3–4 lines in diameter; the ovary, subglobose, 4-grooved, is seated on a lobed disk; the stigma is six times as long as the very short style, has a basal ring broader than the ovary, is shortly conical, obtuse, cleft halfway into two obtuse 2-dentate seg-

ments : the fruit, consisting of two nuts enclosed in the persistent calyx, is polished and glabrous.

10. *Cochranea hispidula*, n. sp. ;—crebre ramosissima, ramis subrugoso-striatis, ramulis subdivergentibus, teretibus, brunneis, pilosis ; foliis fasciculatis, sessilibus, spathulato-linearibus, obtusis, marginibus valde revolutis, carnosulis, fusco-viridibus, undique hispidulis ; paniculis in ramulis terminalibus, brevibus, bis dichotome divisis, pubescentibus ; ramis ultimis 2-seriatim spicatifloris ; floribus paucis, crebris, sessilibus ; stigmate stylo 6-plo longiore, apice 2-fido, laciniis 2-dentatis.—In Chile boreali : *v. s. in herb. Hook.* (Lobb, 440).

This is evidently a low-growing shrub, with extremely crowded, elongated branchlets, 3–4 lines apart, 8 or 9 inches long, the lower ones again branching, the upper ones simple : the axils are 3 lines apart ; the leaves are 4–6 lines long, ½ line broad. The peduncle of the inflorescence is 6 lines long, its branches 6 lines long, their ultimate 2- or 3-spicated branchlets being 9 lines long ; the calyx is tubular, cleft halfway into five erect teeth, is pubescent on both sides, 1 line long ; the tube of the corolla is 1 line long, pubescent outside, with a border 2 lines in diameter ; the pistil is 1 line long ; the stigma, eight times the length of the style, annular at base, slenderly conical, cleft for a quarter of its length into two bidentate segments.

11. *Cochranea chenopodiacea*;—Heliophytum chenopodiaceum, *A. DC. Prodr.* ix. 553 ;—Heliotropium chenopodiaceum, *Gay, Chile*, iv. 458 ;—nana, divaricato-ramosissima, glabella ; ramulis subrigidis, teretibus, flavidulis, junioribus obsolete puberulis ; axillis cupula prominente munitis ; foliis fasciculatis, parvis, spathulato-linearibus, subteretibus, marginibus valde revolutis, carnosulis, fere sessilibus, glabris vel subviscosis : paniculis terminalibus, bis dichotome divisis, ramis ultimis tenuibus, spicatifloris ; floribus paucis, sessilibus, pallide cæruleis ; calyce tubuloso, 5-dentato, extus pilosulo ; stigmate stylo 2-plo longiore, apice obtuso, breviter bifido.—In Chile : *v. s. in herb. Hook. ex Mus. Paris.*, prov. Copiapo, ad montes Arqueros (Gay).

This plant was found by Gay in the more northerly province of Copiapo, in the silver-mining district of Arqueros, and is distinct from the plant I have referred to *C. filifolia*, which has been confounded with it. Gay says it is a low shrub, not more than a foot high, with many short stiff spreading branches, which are terete, covered with a yellowish,

shining epidermis. The fasciculated leaves are very small, somewhat glutinously rugulose, 1 or 2 lines long, scarcely ¼ line broad; the terminal inflorescence has its spicated branchlets 6 lines long; the calyx is broadly tubular, 1 line long, cano-pubescent outside, divided halfway into five triangular teeth; the tube of the corolla is a trifle longer than the calyx, cylindrical and pilose outside; the pistil is as long as the tube of the corolla; the ovary semiglobose, seated upon the disk; the stigma, annular at base, is rather longer than the style, conical, and divided at its apex into two short obtuse segments. The glabrous fruit consists of two nucules, each 2-celled.

[To be continued.]

XII.—*On* Phidiana lynceus *and* Ismaila monstrosa. By Dr. Rud. Bergh*.

[Plate I.]

The genus *Phidiana*, Gray, may be thus characterized:—

Phidiana, Gray.

Corpus gracilius, elongatum. Rhinophoria perfoliata; tentacula elongata. Papillæ dorsales in series obliquas confertas dispositæ. Podarium antice rotundatum vel subtruncatum.

Margo masticatorius mandibulæ singula serie denticulorum præditus. Radula paucidentata, dentibus uniseriatis armata.

This genus agrees, with regard to the structure of the rhinophoria, with the more remote genus *Antiopa*, as well as with *Flabellina*, Cuv., from which latter, however, it is easily distinguished by the bases of the papillæ and by the produced anterior corners of the foot in *Flabellina*; but the statements of Dr. Gray and Messrs. Alder and Hancock, as to the occurrence of lateral teeth in the latter genus, were not borne out by a more recent examination of this point in a new species, *Fl. Semperi*, Bgh. *Facelina*, Ald. & Hanc., is also easily distinguished by the produced corners of the foot. *Spurilla*, Bgh. (see the 'Transactions of the Royal Danish Society of Sciences,' vii. 1864, p. 205), forms an intervening link between *Phidiana* and the more typical Æolididæ, particularly *Æolidiella*, a new genus, comprising as yet four species (viz. *Æ. Sœmmeringii*, F. S. Leuckart, *Æ. occidentalis*, Bgh., n. sp., *Æ. glauca*, A. & H., *Æ. Alderi*, Cocks), and which may be thus characterized:—

Æolidiella, Bgh.

Forma corporis, rhinophoria, tentacula, papillæ et podarium ut in *Æolidiis* sensu strictiore.

* Extract from 'Videnskabelige Meddelelser fra den naturhistoriske Forening i Kjöbenhavn' f. 1866.

Margo masticatorius mandibulæ minutissime longitudinaliter plicatus. Dentes radulæ uniseriati. Dentes pectiniformes, medio emarginati.

Only four species can with certainty be classed under *Phidiana*, viz. *Ph. inca* (d'Orb.), *Ph. patagonica*, d'Orb., *Ph. unilineata*, A. & H., *Ph. lynceus*, Bgh., n. sp. Perhaps *Æ. Alderiana*, Desh. (Frédol?, 'Le Monde de la Mer,' 1864, p. xi, f. 7) and *Æ. northumbrica*, Ald. & Hanc., also belong to *Phidiana*. An anatomical examination of *Ph. lynceus*, Bgh., affords several interesting results, particularly with regard to the organs of vision. The eye was observed in the middle of the external margin of the cerebro-visceral ganglion. Immediately behind the eye, and a little further in, another, smaller, shortly pedunculate globular body was observed, which proved to be an accessory eye; the diameter was 0·05 to 0·06 millim., the pigment black, the lens small, colourless, with a small yellowish kind of nucleus. Close behind the accessory eye a vesicle, sparingly filled with cells and nuclei, with thin walls, was seen to protrude from the surface of the ganglion. This vesicle might be the auricular vesicle; no other organ that could be so interpreted was found. Whilst plurality is a frequent phenomenon amongst Acephala and Tunicata, no instance of the normal occurrence of more than one pair of eyes was hitherto recorded in the class of Gasteropoda. The earlier statements concerning the occurrence of such an arrangement in the genus *Diplommatina* (Bens.) turned out to be founded on a misconception*. Nor was Claparède able to find the black spot which Moquin-Tandon stated he saw in *Neritina fluviatilis* behind the true eye, and which he described as being like an accessory eye†. Agassiz states, in his 'Lectures on Comparative Embryology,' 1849, p. 86, that on a little *Margarita* from the roadstead of Boston, he had seen a row of eyes placed at the base of the tentacles of the epipodial fringe. But this statement is not borne out by the results of a careful examination of *M. grönlandica* and *M. cinerea*. When viewed from beneath, the tentacles of the epipodial fringe in *M. grönlandica*, Ch., are seen to issue each from a small depression, of which the inner margin is almost always swollen in the middle, and contains a varying quantity of black pigment; sometimes this pigment is disposed in the shape of a ring, and in that case these tubercles assume a striking similarity to eyes. These tubercles resembling eyes are of very different shapes, sometimes rather oval; in some cases the pigment is continued along the lateral

* Comp. A. Adams in 'Ann. & Mag. N. Hist.' ser. 2. vi. 1860, p. 113, and *ibid.* xii. 1863, pl. vii. figs. 11, 12.

† Comp. Claparède in Müller's 'Archiv,' 1857, p. 139, and Moquin-Tandon in 'Hist. Nat. des mollusq. fluv. et terr. de la France,' ii. p. 522.

margin of the depression in which the tentacle stands, and even further, so as to form a narrow black border along the lobe between two succeeding tentacles; in these cases the underside of the base of the tentacle is occasionally also coloured. In some individuals no pigment was observable, and the tubercles were then generally but little developed. These latter are of a firm consistency; and their colour is due to peculiar cells, which stand perpendicular on the surface, and much resemble those observed in the eyes of various mollusca. No ganglion could be found in the base of the tubercles; and therefore the tubercles in question cannot even be regarded as merely photoscopic eyes, much less as corresponding in structure with the real eye of these animals. Something similar, but in smaller degree, was observed in *M. cinerea*, Couth. (var. *grandis*). The real eye in *Margarita* was seen as a black spot shining through the apex of the ophthalmophorium; and on this spot a small oval opening was observed, of varying size, and which could be distended by pressure. No lens, nor apparently any vitreous humour existed. A similar opening seems to exist on the eye of *Fissurella rosea* (Lam.). If these observations are confirmed, the eye will in these animals exhibit the same remarkable structure, without dioptric apparatus, which has been found in *Nautilus*. To return to *Phidiana lynceus*, it may be observed that a doubling of the eye on one or both sides has certainly been observed as a monstrosity in many Gasteropoda; but the occurrence of accessory eyes in the *Phidiana* was certainly no monstrosity, for the three individuals examined agreed perfectly in this respect. Nor could these organs be interpreted in any other way than as eyes. There exist, no doubt, Æolididæ in which the ear remains in its embryonal stage, with one otolith; but, excepting a few Pteropoda, there exists scarcely any Gasteropod in which the ear exhibits such a development of pigment as is seen in the organs referred to in *Phidiana lynceus*.

The band or tube connecting the sacs which contain the urticating cells with the lobes of the liver was unusually long in this species, rolled up in a coil generally placed on one side of the lobe. Both cysts and free urticating cells were seen dispersed through the whole length of the tube. Dr. Bergh does not agree with the theory advocated by Prof. Huxley, Dr. Gosse, and Mr. Strethill Wright, that the urticating cells in Æolididæ are a kind of fæcal excretions, and derived from the animals on which they live; for sacs containing urticating cells are wanting in many genera, as *Embletonia*, *Fiona*, *Phyllodesmium*, in Hermacinæ and Proctonotinæ, though these, or at any rate most of them, certainly feed upon animals which

possess urticating cells. Besides it is easy to show that in several Æolididæ (for instance, species of *Glaucus*, which live almost exclusively on one kind of food, *Vellella* and *Porpita*) the urticating threads found in the digestive tube and derived from the food are quite different from those found in the urticating cells and secreted by the animals themselves. Nor does that theory agree with the fact that the urticating cells are to a great extent not free in the sacs, but enclosed in cysts, and become free only by the bursting of the latter. Dr. Bergh refers finally to the great analogy in anatomical respects between Æolididæ and Pleurophyllididæ, and concludes that the urticating cells in the sacs are the product of the Æolididæ themselves, and not derived from their food.

On the back of one of the specimens of *Phidiana lynceus*, immediately behind the second group of papillæ, a deep depression was observed, as if some body had been located there but had fallen off; in the middle of this depression an irregular round opening of 0·25 millim. diameter was seen. The sexual gland was very much atrophied, only the foremost and hindmost lobes being well developed. In the second specimen a round opening, 0·75 millim. broad, was observed in exactly the same place as in the first specimen, and a pointed prominence was seen in the opening; another, much smaller opening was seen in front of the one described. On the sides of the animal several yellowish slanting bodies seemed to shine through the integuments from inside. When the inner cavity was examined the greater part of the space usually filled by the sexual gland was occupied by a parasite, the gland being atrophied as in the first individual. The parasite was a Copepodous crustacean, with the back downwards, the head forwards, and the posterior extremity reaching out into the larger opening before described. This crustacean reminded one of the *Splanchnotrophus brevipes* of Hancock and Norman, but differs from this in several important points, viz. the well-developed large cephalothorax, the articulated abdomen, the absence of true limbs, the peculiar arm-like lateral prolongations of the body, the dorsal prolongation, and the remarkable prolongation of the abdomen (which forms a kind of tail).

The only specimen was a female: no males could be discovered; and Dr. Bergh recalls with good reason Professor Kröyer's remark, in his last contribution to the history of parasitic Entomostraca (Naturhistorisk Tidsskrift, ser. 3. ii. 1863, p. 396), that "whenever the incompleteness of our knowledge compels us to found genera on females only, or to group species of which only the female is known together with others

of which both sexes are known, it must always be carefully borne in mind that such arrangements are only provisional, and can only be definitely settled when the males shall have been examined." Nevertheless he ventures, with all due reservation, to give a generic character of the new parasite found in the *Phidiana*, and which he calls *Ismaila*.

Ismaila, Bgh., n. g.

Fœmina.—Cephalothorax distinctus. Duo antennarum paria; antennæ priores minutæ; posteriores paullo majores, prensoria. Abdomen supra in tria segmenta divisum, ultimum in appendicem erectam productum; segmenta omnia utroque latere in brachium elongata; duo priora segmenta inferiore pagina, pedum abdominalium loco, duobus paribus brachiorum inter sese similium prædita. Cauda elongata, apice solum articulata, ultimo segmento appendicibus caudalibus brevissimis setigeris.

Mas ignotus.

The mouth was furnished with a very powerful pair of mandibles. The species is called *Ism. monstrosa*, n. sp.

Dr. Bergh has observed the *Spl. brevipes*, Hanc. & Norman (♀), in a new species of *Galvina* from the Kattegat, *G. viridula*, Bgh.; a specimen of *G. rupium* yielded another parasite, namely an oceanic Acaride, of which some very few have been observed before. Having on a former occasion given a less accurate description of the rasp in *Galvina rupium*, the author now supplies the deficiency by an accurate drawing showing a peculiar depressed position of the apex, which is not seen from above, and therefore not observable in the figures given by Hancock (Monogr., suppl. pl. 47. figs. 25–27), but which seems to be found in all species of *Galvina*.

EXPLANATION OF PLATE I.

Fig. 1. The rasp of *Phidiana inca*, D'Orb., from the side.
Fig. 2. A dental plate of the same, from underneath.
Fig. 3. A part of the rasp of *Phidiana lynceus*, Bgh., from the side.
Fig. 4. A dental plate of the same from above obliquely.
Fig. 5. The apex of a rhinophore of the same.
Fig. 6. The middle dental plates of *Galvina rupium*, Möll., from the side.
Fig. 7. The same, from above.
Fig. 8. The central part of the nervous system of *Phidiana lynceus*: *a*, ganglion olfactorium; *b*, gangl. cerebroviscerale; *c*, gangl. pediæum; *d*, gangl. buccinatorium; *α*, commissura pediæa; *β*, comm. visceralis (branchialis); *γ*, commissura buccalis; *δ*, comm. sympathica.
Fig. 9. The larger eye of *Phidiana lynceus*.
Fig. 10. The smaller eye of the same.
Fig. 11. The epipodial margin of *Margarita grönlandica*, Ch., with the round bodies resembling eyes.
Figs. 12 & 13. Small bodies resembling eyes.

Figs. 14, 15, 16. Cells from the surface of the latter.
Fig. 17. Cells from the stratum containing the pigment of the true eye.
Fig. 18. The true eye of *Margarita grönlandica*, from the side.
Fig. 19. The same, from the front.
Figs. 20, 21, 22. *Ismaila monstrosa*, in different positions.

XIII.—*On* Spirifer cuspidatus.

To the Editors of the Annals and Magazine of Natural History.

University of London.
July 20, 1868.

Gentlemen,

I have no intention of discussing with Prof. King the validity of the generic distinction which has been affirmed to exist between *Syringothyris* and *Spirifer*, since this distinction was not laid down by myself, and the main question involved in it lies beyond the scope of my own researches. But, for the sake of those who are associated with me in this matter, I feel it necessary to make a few remarks upon that portion of his argument which relates to the microscopic structure of the shell in these two types respectively.

Prof. King, having been allowed, by the kindness of Mr. Davidson, the fullest opportunity of examining the singularly well-preserved specimen of *Spirifer cuspidatus*, of which I described the structure in my last communication on this subject, and having found himself equally unable with myself to discern in it any trace of those perforations which he has so persistently asserted to exist in that type, supplies the deficiency out of the depths of his own inner consciousness. "Impressed," he tells us, "with the preceding evidences and considerations, I can only conclude that, wherever imperforate *spaces* occur in *Spirifer cuspidatus*, perforations were originally present in them. And although Mr. Davidson's specimen (also, it must be remembered, Prof. Harkness's) may be noted as 'exhibiting not the smallest trace of perforations,' I have no hesitation whatever in adopting the same simple conclusion in this case as well, rather than seek for its explanation in any strange morphological doctrine."

What "strange morphological doctrine" is involved in the assertion that the true *Spirifer cuspidatus* belongs to that "imperforate" type which I showed to exist among Brachiopods, at the very time when I first demonstrated* that the "punctations" by which the true Terebratulidæ and certain Spiriferidæ are characterized are the orifices of "perforations," I must own

* Reports of the British Association for 1844.

myself unable to discover. But however "strange" it may seem to Prof. King, I re-affirm, as a simple fact of observation, capable of being at once verified by any competent and unprejudiced microscopist, that not only do my preparations of this shell show "not the smallest trace of perforations," but they exhibit *a continuity of shell-structure* where the perforations *ought* (in Prof. King's idea) to be seen, which is not surpassed in distinctness by that of a recent *Rhynchonella**. No metamorphism could *produce* shell-structure where none previously existed.

For anything I know to the contrary, however, Prof. King may still hold to the conclusion which he expressed with as little hesitation some twenty years ago †, not only that *Spiriferidæ*, but that *Rhynchonellæ* (or *Hypothyrises*, as he then designated them) are perforated. For although he has been repeatedly challenged, both publicly and privately, either to justify or to retract that statement (which, to use plain English, gave the lie to the figures and descriptions I had published four years previously), he has never, so far as I am aware, explicitly done either the one or the other.

Now, as there cannot be any common basis of discussion between Prof. King and myself, so long as he "doubts the absence of perforations in any Brachiopod whatever," and as he appears at last to have made himself acquainted with the shell-structure of the recent *Rhynchonella psittacea*, to which I long since directed his attention as affording conclusive evidence on this point, I think that the scientific world has a right to know his present opinions on the following questions:—

1. Do any traces of perforations exist in the shells of the recent *Rhynchonella psittacea* and *Rh. nigricans*?

* Compare my representations of the minute structure of the shell of *Rhynchonella psittacea* in 'Reports of the British Association' for 1844, figs. 27–30, or in my Introduction to Mr. Davidson's Monograph, plate 5. figs. 4, 5, with the representations of the structure of the perforated *Terebratulidæ* given in figs. 34–36 of the same 'Reports,' or in pl. 4. figs. 6, 7 of the 'Introduction.' It is needless to repeat figures so well known.

† "Dr. Carpenter places *Hypothyrises* in his non-perforated division of the Brachiopods; but punctures, though much more minute than those in Terebratulidæ, occur in every species that has passed under my observation. Punctures also occur in Productidæ and Spiriferidæ; in short, I doubt their absence in any Brachiopod whatever." (Permian Fossils, p. 110, note.)

"But unfortunately for Dr. Carpenter's observation and Dr. de Koninck's conclusion [as to the imperforateness of the Palæozoic Spirifers], I have seen punctures in species of every genus of Spiriferidæ, so that I am led to conclude a punctated structure characterized the entire family." (*Op. cit.* p. 124.)

2. Is there any reason for supposing that these shells have ever been perforated?

3. Do any traces of perforations exist in the fossil *Rhynchonellæ* generally? (Of course I do not expect Prof. King to surrender *Rhynchopora Geinitziana*; but I speak of such types as *Rh. acuta*, *octoplicata*, and *rostrata*.)

4. Is there any reason for supposing that these shells have ever been perforated?

If Prof. King does not yet feel himself able to give that direct and explicit negative to these questions, in which I have reason to believe that all other brachiopodists are agreed, it is to be hoped that he will feel it due to science to justify his affirmative conclusion by publishing the evidence on which it rests. If, on the other hand, he is now prepared to admit that which he formerly so unhesitatingly denied, I have further to ask :—

5. What appearances are presented by Mr. Davidson's specimen of *Spirifer cuspidatus* which place it in a different category from the foregoing as regards the supposed existence of perforations?

When Prof. King shall have given a plain answer to these questions, those who are interested in this subject will be able to judge for themselves whether the *invisible* perforations which he sees with his mind's eye in Mr. Davidson's specimen of *Spirifer cuspidatus** are anything else than a delusion of that too vivid imagination which, twenty years ago, led him to assert their existence in *Rhynchonellæ* and *Spiriferidæ* generally, and to doubt their absence in any Brachiopod whatever. And it will then be quite time enough to inquire into the validity of Prof. King's observations upon Prof. Harkness's and other specimens, detailed in his last paper.

I may add that I possess sections of two Devonian species (*Sp. speciosus* and *Sp. Verneuilli*) in which *the continuity of imperforate shell-structure* is, if possible, even more distinct than in Mr. Davidson's specimen, in consequence of the entire absence of metamorphic change. These and any other of my

* I rest the whole case of the imperforation of *Spirifer cuspidatus* upon this specimen, for two reasons,—first, that it has the best-preserved shell I have ever met with in a Carboniferous-limestone fossil; and, secondly, because Prof. King has examined this very specimen, so that there can be no question about the appearances which its structure presents. But the most careful examination of those appearances has only confirmed the statement I originally made, when the question was simply one of observation, not involving any "strange morphological theory"—that, "although the structure of this shell is often obscured by metamorphic action, I possess sections in which it is extremely well preserved, and in which there is an evident *absence* of the perforations." (Rep. Brit. Assoc. 1844.)

preparations are open to the examination either of Prof. King or of any other naturalist interested in the question, on the simple condition that the results of such examination shall be made public in a form satisfactory to myself. I do *not* require that these results shall accord with my own; I only ask that simple facts of observation shall not be twisted into conformity with preconceived theories, and that, where accordance exists, it shall be freely admitted.

I remain, Gentlemen,
Your obedient Servant,
WILLIAM B. CARPENTER.

XIV.—*On some new Species of Diurnal Lepidoptera from South America.* By OSBERT SALVIN, M.A., F.L.S., &c., and F. DU CANE GODMAN, F.L.S. &c.

HAVING recently acquired several interesting collections from the eastern valleys of the Andes of Bolivia, Peru, and Ecuador, we hasten to publish descriptions of some of the most prominent of the species which appear to us to be undescribed. To these we have added others which have been recently sent to us from several parts of Central America and Mexico. It is not our intention to leave these species, of which we now merely give isolated descriptions, in this "unprotected" state; but as time shall enable us to work out the more difficult groups, we purpose giving a more detailed account of all the species contained in these collections, and a complete record of all the localities where the species were obtained. Besides the species here described, these collections contain others which we have little doubt are new to science, especially such as belong to the genus *Ithomia* and its allies; but as these groups require a more careful study than we have as yet been able to bestow upon them, we leave them for the present.

1. *Callitæra pyropina.*

♂. Exp. 2·85. Diaphanous, nervures brown; posterior wings with an evanescent band between the end of the cell and the anterior angle, and the whole of the outer margin diaphanous brown, broad at the posterior angle, where it encloses three round spots, between each of which and the margin is a narrow transverse streak; this portion of the wing is clothed, the transparent film with dark pink-coloured scales, the diaphanous brown portion with violet-coloured scales: between the radial nervures and close to the extremity of the wing is an ocellus of very dark blue scales, surrounded by the diaphanous

brown of the margin, this ocellus has a white pupilla, and there is another isolated white spot between the third median branch and the lower radial. The underside of the posterior wings differs from the upper as follows:—the pink-coloured spots are much paler, and the brown markings near the posterior angle are covered with scattered brown (instead of violet) scales: the ocellus has a buff submarginal ring.

♀. Larger, the wings more rounded, and the colours of the posterior wings more vivid; a small white spot appears in the centre of the pink spot between the second and third median branches.

Hab. Eastern Peru, Lower Huallaga (*E. Bartlett*), Pozzuzo (*Pearce*).

Mus. S. & G.

Nearest to *Hetæra Esmeralda*, Dby., but is much larger, the wings more elongated, the pink spots on the posterior wing larger, and the colouring of this portion much more extended.

2. *Pierella rubecula.*

♂. Exp. 3·1. Brown, the anterior wings with a green opalescence; the posterior wings have the terminal half, except the actual margin, deep rufous, and two black ocelli at the anterior angle, that nearest the costa having a white pupilla: three narrow black bands, the inner two very faint, cross both wings, the outer band being nearly straight, the others convex; the innermost band, where it crosses the cell, is separated into distinct spots. The underside uniform and paler, washed with a purplish tinge and covered with faint darkish freckles; the cross bands are more distinct: there are also small distinct black spots at the base of both wings, and a series of indistinct white spots follow the ocelli; the anterior wings have three small white spots near the apex.

♀. Larger, the anterior wings less acute, and the general coloration darker, the markings being more distinct.

Hab. Guatemala, forests of Northern Vera Paz and valley of the Polochic (*Salvin & Godman*).

Mus. S. & G.

Near *Hetæra luna* (F.), but may be at once recognized by the very distinct rufous patch on the posterior wings.

3. *Hetæra pallida.*

H. luna, Hew. Ex. Butt. ii. t. 42. f. 3.

All specimens from Nicaragua resemble the drawing given by Hewitson as representing *H. luna* (F.). These differ from South-American specimens, which must be considered to be

the true *Papilio luna* of Fabricius, in being uniformly much paler in colour. This Nicaraguan race, having apparently permanent characters and a distinct geographical habitat, requires a name. We propose to call it *Hetæra pallida*.

4. *Pierella ocreata.*

♂. Exp. 2·75. Dark brown, the anterior wings have three black bands crossing the cell, the middle one being prolonged to the inner margin; the end of the cell is also black: two parallel black bands cross the wing from the inner margin to the costa, the innermost traversing the third section of the median nervure; between these bands and the outer margin are a series of spots, that nearest the costa white, the next black, and the two following white: the posterior wings have three black cross bands, being the continuation of the first, second, and fourth of the anterior wing; beyond the third of these bands is a large white patch, followed by a red one, the latter having a transverse irregular lower margin, and enclosing a distinct white spot between the third median branch and the lower radial; beyond these patches the wing is darker, and has a white spot between the upper radial and subcostal nervures, and a pupillated black ocellus between the radials; the outer margin is rather deeply indented, the end of the third median branch carrying a somewhat prominent tooth; the indentations are all margined with buff. The general coloration of the underside is paler, the bands being more strongly shown; between the two parallel bands is pale greyish, which is continued on the posterior wings as a large angulated patch tinged with red over its lower portion: the neighbourhood of the anal angle is tinged with buff, and a buff line between two black lines follows the sinuations of the outer margin: a third white spot appears between the second and third median branches, and the ocellus has a buff submarginal ring. The anal patch, characteristic of the males of this section, is dark brown.

♀. Larger and darker, the anterior wings being less acute; the underside of the posterior wings has a fourth white spot between the first and second median branches.

Hab. Panama (*M'Leannan*), Veragua (*Arcé*).

Mus. S. & G.

Allied to *H. helvina* of Hewitson, from which it manifestly differs in having the upper portion of the red spot white.

5. *Antirrhœa pterocopha.*

♂. Exp. 3·85. Apex of the anterior wings not rounded, but abruptly obtuse, the outer margin being angulated at the

extremity of the upper radial; posterior angle definite and obtuse: posterior wings with the extremity of the first branch of the median nervure prolonged into an obtuse, and the third branch into an acute projection: anterior wings brown, with three bluish-white spots between the extremity of the cell and the outer margin: posterior wings brown at the base, black at the extremity, an irregular tawny spot at the anterior angle; posterior angle with a succession of three blue spots across the wing, that between the second and third branches of the median nervure whitish in the middle. Underside brown; a curved black band crosses both wings from the anal angle of the posterior wings to the extremity of the cell of the anterior; another, parallel line between this and the base of the wings: between these lines on the anterior wings is a median black line crossing the cell; all these lines have whitish outer margins gradually separating into freckles, so as to give the under surface a mottled appearance: outer margin of both wings deep tawny, a conspicuous black spot between the angle of the costal and subcostal nervures of the posterior wings. Antennæ brown.

Hab. Veragua (*Arcé*).

Mus. S. & G.

The specimen from which our description is taken is in bad condition, but is sufficiently perfect to enable us to point out the remarkable characters of this conspicuous species. We are not aware that it has any near ally.

6. *Oressinoma sorata.*

♂. Exp. 2·2. Like *O. typhla*, Klug, but differs in being larger, the posterior wings much more elongated at the anal angle, the anterior wings more angulated, and the outer margin straighter; the white band which crosses both wings is narrower and straighter; the indistinct submarginal markings of *O. typhla* are replaced by distinct white lunules on the hinder wings, and by a straight whitish line on the anterior wings; on the underside the buff submarginal edging of the posterior wings is less abruptly sinuated, and the white band has a dark inner margin.

Hab. Callcan, Northern Bolivia (*Pearce*).

Mus. S. & G.

7. *Acræa testacea.*

♂. Exp. 1·9. Both wings sooty, the nervures being rather darker; the anterior wings between the costal and median nervures, and almost as far as the end of the cell, brick-red; an oblique band of the same colour beyond the cell reaches

from the costa to the second branch of the median nervure. Underside paler, the posterior wings yellowish, the nervures and a line between them sooty. Antennæ black.

Hab. Apolobamba, Northern Bolivia (*Pearce*).

Mus. S. & G.

8. *Heliconius notabilis.*

♀. Exp. 3·1. Dark sooty black; anterior wings with two conspicuous white spots—one (quadrate) at the extremity of the cell, the other (oval) between the cell and the apex; the margins of these spots and a large patch contiguous to the inner one, and reaching to beyond the first branch of the median nervure, brick-red. Underside paler, the red spot only showing a pinkish tinge; the basal half of the costa of the posterior wings yellow; four red spots at the base of the posterior wings. Antennæ black.

Hab. Canelos, Eastern Ecuador (*Pearce*).

Mus. S. & G.

Allied to *H. Xenoclea*, Hew., but differs in having the spots of the anterior wings white and red, instead of red orange.

9. *Eueides lineata.*

♂. Exp. 2·4. Black; anterior wings with a broad arched band from the base, widening towards the outer margin and posterior angle, tawny orange; an oblique curved band, divided by the radial nervures, occupying the central portion of the apex, reaches to the costa; hind wings with the whole central portion tawny orange, the black margin extending almost to the cell along the nervules, and to a less distance between them. Underside red brown intermingled with yellowish about the apical third of the anterior wings: posterior wings having the nervules dark, a red-brown longitudinal mark between them, the base yellowish, and a row of thirteen white spots close to the outer margin. Antennæ black, a row of lateral white spots on the abdomen, and four on the head.

♀. Larger and paler.

Hab. Guatemala, valley of the Polochic (*H. Hague*).

Mus. S. & G.

10. *Eresia mœsta.*

Exp. 2·55. Grey, both wings bordered with brownish black, the nervures being of the same colour; apex of the anterior wings with a row of four submarginal white spots; posterior wings with five white spots round the anterior angle and outer margin; a patch of tawny yellow along the inner margin and anal angle. Underside paler, the tawny patch more apparent, the base of the costa of the posterior wing

yellowish grey. Antennæ yellowish white, black at the base, the club being tipped with tawny orange.

Hab. Canelos, Eastern Ecuador (*Pearce*).

Mus. S. & G.

This species has some resemblance to *Ithomia cæno*.

11. *Eresia phœdima.*

♂. Exp. 2·4. Anterior wings black; basal portion of the cell, part of the inner margin, and the whole space between the submedian nervure, the median and its first branch almost to the posterior angle, tawny yellow; terminal portion of the cell, a large patch between the first and second branches of the median nervure, and a smaller one between the second and third, dingy yellow; a series of three elongated spots of the same colour between the cell and the outer margin; six white submarginal spots between the nervules: posterior wing tawny yellow, with costal and outer margins black, the latter with six white submarginal spots. Underside paler, the white submarginal spots more prominent, the dingy yellow spots of the upper surface clear yellow; a central band of the same colour crosses the posterior wings, the costa of which is tawny yellow. Antennæ black, the club yellow.

♀. Larger. The basal tawny-yellow marks of the anterior wings more restricted, and the marks of the apical portion of the wing greyer and larger; the white submarginal spots of both wings more distinct: posterior wings with a white spot near the anterior angle next the margin. Underside with the markings of the terminal half of the anterior wings and the central portion of the posterior wings white. Antennæ with the basal third only black.

Head in both sexes black; fore part of the palpi and two spots between the eyes white. Abdomen tawny above, with a central black line, beneath yellowish white.

Hab. Pozzuzo, Eastern Peru (*Pearce*).

Mus. S. & G.

12. *Callicore eupepla.*

The recent acquisition of a Venezuelan specimen of *Callicore Metiscus*, Dby., has convinced us that there are three very distinct races of this form of *Callicore*, which may be shortly characterized as follows:—

Callicore Metiscus, Dby. Gen. Diurn. Lep. t. 30. f. 5.

Has the refulgent spot of the anterior wings subtriangular, the inner edge being straight and cutting the median nervure at a slightly obtuse angle; between this spot and the base of the wing are a few scattered bluish scales. The refulgent

spot on the posterior wings is large and only slightly tinged on its inner edge with blue; beneath, the red of the anterior wings is confined to a quadrate spot within the cell; the bend only of the costa of the posterior wings is red, this colour not reaching to the base of the wing; a small branch, however, leads into the basal black transverse band.

Hab. Venezuela (*Sallé*).

Mus. S. & G.

Callicore eupepla, sp. n.

The refulgent spot of the anterior wings, except along the costa, reaches to their base, the lower portion being bluish. On the posterior wings the refulgent spot blends into a rich blue, which pervades the whole of the wing. Underside—a broad band of red crosses the anterior wings near their base: the costa of the posterior wings is red for two-thirds of its length, and beyond the termination of this colour is a quadrate spot, also red.

Hab. Costa Rica (*Carmiol*).

Mus. S. & G.

13. *Callicore phlogea*, sp. n.

The refulgent spots are narrower than in either of the preceding species, and, looking at both anterior and posterior wings, form a crescent-shaped mark; the posterior wings are suffused with blue; underside, the basal half of the anterior wings, except the base itself, is red. The costa of the posterior wings is red for two-thirds of its length, this colour branching at its base as in *C. Metiscus*.

Hab. New Granada, Bogota (*Sp. ex Dr. C. Felder*).

Mus. S. & G.

14. *Batesia hypoxantha*.

Like *B. hypochlora*, Feld. (Voy. Nov. t. 53. f. 1, 2), but differs in the following characters. The upper surface is greener where *B. hypochlora* is blue, a submarginal band of the same colour surrounding the outer margin of the posterior wings. The red spot of the anterior wings is pinker. Beneath, the hind wings are pure yellow, not green as in *B. hypochlora*, the last-mentioned species having a well-defined submarginal band of the same colour, whereas in the present insect this band is indistinct.

Hab. Pebas, Upper Amazon (*Hauxwell*).

Mus. S. & G. et H. W. Bates.

15. *Batesia hemichrysa*.

Like *B. hypochlora*, but differs in having the hind wings

beneath and the apical spot of the fore wings clear golden yellow instead of green. In the same way it differs from *B. hypoxantha*, which has these markings pale yellow. The submarginal band of the hind wings is distinct as in *B. hypochlora*.

Hab. Guadalquiza, Ecuador (*Pearce*).
Mus. S. & G.

We think that neither of these species can be justly referred to *B. hypochlora*, Feld. The plate above referred to represents the colouring of the underside of the hind wings as green, whereas in one of our proposed species this portion is yellow, and in the other golden, almost orange.

16. *Paphia cyanea.*

♂. Exp. 3·25. Apex of the anterior wings angular, posterior wings with a marginal appendage; wings glossy blue, black towards the costa and outer margin; a wide refulgent blue band crosses the hind wings from the posterior angle, past the end of the cell to beyond the second branch of the median nervure of the anterior wings; this band is followed by a spot of the same colour between the radial nervures, another being situated between the upper radial and subcostal nervures. Entire surface beneath silvery white, covered with minute transverse black lines, interspersed on the anterior wings with darker patches: posterior wings lighter, the anal half of the outer margin occupied with a buff-coloured elongated mark with a green margin, and containing five white lunules tipped externally with a blue followed by a black spot; palpi streaked with seven lines alternately black and white. Antennæ black, with whitish marks beneath.

Hab. Canelos, Ecuador (*Pearce*).
Mus. S. & G.

Certainly a *Paphia*, but quite unlike any member of the genus in coloration.

17. *Paphia tyrianthina.*

♂. Exp. 3·50. Like *P. centaurus*, Feld., but has the anterior wings more falcate and elongated; a short middle discoidal nervure is also present; the purplish tint is more diffused and less broken up by blue markings; the posterior wings have no marginal appendage; the underside is generally darker and the cross lines less distinct.

Hab. Apolobamba, Bolivia (*Pearce*).
Mus. S. & G.

18. *Morpho Justitiæ.*

♂. Like *M. theseus*, Deyr., but the base of the wings is rich brown instead of hoary grey, the margin is much darker, and the brown spots clearer, the submarginal row of the hind wings being further from the margin, the dentation of which is deeper; the anterior wings are more acute and elongated beneath, the markings within the cell are less distinct, while those in the neighbourhood of the two ocelli, between the branches of the median nervure, are much clearer, and approach nearer to the ocelli; the pale band above the ocelli of the posterior wings is narrower in *M. Justitiæ*.

Hab. Guatemala, valley of the Polochic (*Hague*).

Mus. S. & G.

19. *Eurygona aurantiaca.*

♂. Exp. 1·75. Above tawny orange; the apical half of the anterior wings and the anterior angle of the posterior wings black, the inner edge of the former irregular; inner margin of the hind wings dusky. Beneath yellowish white, an indistinct band crossing both wings beyond the cell; a row of indistinct submarginal spots. Antennæ brown, the club black.

Hab. San Geronimo, Vera Paz (*Hague*).

Mus. S. & G.

Like *E. Teleclus*, Stoll, but the tawny yellow of the upper surface is much more extensive; beneath it is much less silvery and the marks less distinct.

20. *Eurygona Hieronymi.*

♂. Exp. 1·30. Above dark brownish black, with a line of tawny red running parallel to the inner margin of the posterior wings. Beneath greyish brown; a narrow tawny band edged with black crosses both wings beyond the cell, and another faint band between it and the outer margin: hind wings with a black spot, edged externally with white between the second and third branches of the median nervure; two whitish dashes edged with black near the anal angle; a succession of indistinct marks surround the outer margin. Antennæ black and white, the club black.

Hab. San Geronimo, Vera Paz (*Hague*).

Mus. S. & G.

21. *Euterpe nigrescens.*

♂. Exp. 2·70. Like *E. Eurytele*, Hew. Ex. B. i. t. 5. f. 1; but the tawny colour of both wings is brighter orange, the yellow spots of the anterior wings are also paler, and there are two elongated yellow spots between the submedian ner-

vure and the first branch of the median; the base of the anterior wing is blacker. Beneath blacker; instead of a large black spot near the middle of the costa of the posterior wings, a black streak unites with the black of the outer margin; wide black marks extend over the vicinity of the median nervure and its branches. Antennæ wanting.

Hab. Guatemala, valley of the Polochic (*Hague*).

Mus. S. & G.

22. *Pieris Josepha.*

♂. Exp. 3·25. Near *P. Josephina*, Gdt. (Hübn. Ex. Schm. ii. t. 126), but differs in the contour of the posterior wings. These wings in *P. Josephina* are elongated, the outer margin being much rounded, the anal angle only slightly projecting; the third branch of the median nervure is fully ·15 longer than in *P. Josepha*, which has the outer margin more straightened, the anal angle prominent, and the wing wider and more triangular. The geographical distribution of the two races is as follows:—

P. Josephina, Antilles (Haiti, and Cuba).

P. Josepha, Guatemala (valley of the Polochic) and Mexico (Oaxaca), Nicaragua.

Mus. S. & G.

We have several specimens of both sexes of both species, and find the above differences constant. Hübner's figure seems to have been undoubtedly taken from an Antillean specimen.

23. *Papilio Fenochionis.*

♂. Exp. 3·55. Like *P. Epidaus*, Bdv., anterior wings more transparent; whole of the outer half of the posterior wings, except a submarginal row of white lunules and two red spots, black. The central longitudinal band is continued into this black spot instead of stopping abruptly at the end of the cell. Beneath, the central red band is edged on both sides by black instead of only on the inside; the whole of the outer portion of the posterior wings, as on the upperside, is sooty black, with a submarginal single row of white lunulate spots.

Hab. Oaxaca, Mexico.

Mus. S. & G.

24. *Papilio euterpinus.*

♂. Exp. 3·95. Wings rounded, entire, the costa much arched, the outer margin of the posterior wings slightly sinuated, but without projecting dentation: black; the upper margin of the cell of the anterior wings and the portion without the cell of the posterior wings thinly sprinkled with yellow scales; a curved band of brick-red colour occupies the greater

portion of the cell, and, extending thence towards the posterior angle, is cut by the second and third median nervures. Beneath browner, the margin of the brick-red band of the anterior wings black, the apical portion of the same wings and the whole surface of the posterior wings thinly covered with yellowish scales. Head and antennæ black.

Hab. Guadalquiza, Ecuador (*Pearce*).

Mus. S. & G.

This fine species is quite unlike any other known member of the genus. It must be placed with *P. Zagreus*, Dby., and its allies. Instead, however, of assuming the garb of *Lycorea*, it takes that of the underside of *Euterpe Callinice*, Feld.

25. *Papilio xanthopleura.*

♂. Exp. 5·80. Anterior wings elongated, acute, the outer margin only slightly concave; outer margin of the posterior wings deeply indented, the third branch of the median nervure bearing the longest projection; inner margin very hairy: black, each space between the nervules terminating at the outer margin of the anterior wings with an elongated, indistinct greenish line; the end of the cell of the posterior wings followed by four radiating patches, separated only by the nervules, bluish green; an oval spot of the same colour between the branches of the subcostal nervure and a similar triangular spot near the anal angle; a row of seven similarly coloured spots surrounds the wing near the margin, the indentations of which are narrowly edged with white; the spot nearest the anterior angle nearly white. Underside brown, the apex of the anterior wings paler; indistinct yellow markings about the end of the cell, and others, rather greener, near the posterior angle, those nearest the margin being divided by the median fold: posterior wings with a row of seven submarginal brick-red spots edged with black; above the spot, at the anal angle, is a subtriangular yellow mark. Antennæ black; a yellow spot behind the eye, another on either side of the origin of the maxillary palpi, others of the same colour on either side of the prothorax, the base of the wings, and the middle of the front part of the thorax; abdomen black, dark brown beneath, with a large yellow patch on either side.

Hab. Eastern Peru, Lower Huallaga (*Bartlett*).

Mus. S. & G.

Allied to *P. Corœbus*, Feld. (Voy. Nov. t. 13. f. *a*, *b*), but abundantly distinct. The remarkable yellow patch on either side of the abdomen distinguish this fine species from every

other of this group. It is, probably, the largest of the American Papilionidæ.

26. *Papilio soratensis.*

♂. Exp. 4·40. Costa moderately curved, posterior angle rounded, outer margin concave; posterior wings dentated, the branches of the median nervure bearing the longest projections: greenish black; a double row of round yellow spots crosses the anterior wings beyond the cell to the posterior angle; the outer margin towards the same angle also yellow: posterior wings with a series of six submarginal, lunulate, greenish spots; all except that next the anterior angle followed by macular blue spots, which are again followed by seven linear greenish spots; the spot at the anal angle reddish, the indentations of the hind wings yellow. Beneath, anterior wings black, with the apex and the whole of the posterior wings brown; the spots corresponding to the series of the upperside are larger, and there is an elongated transverse spot within the cell: the posterior wings are crossed beyond the cell by a curved band with a dark inner margin, the outer edge being deeply indented; a series of pale, lunulated spots near the outer margin; an orange spot with a black centre at the anal angle, followed inwardly by a black spot with bluish centre; there are yellowish hairs along the inner margin. Antennæ black; head, thorax, and abdomen black; a yellow spot on either side of the maxillary palpi; underside of the abdomen tawny.

Hab. Apolobamba, Bolivia (*Pearce*).

Mus. S. & G.

The only species that at all resembles this in form is *P. Cacicus*, Luc.; but from this it materially differs in the arrangement of its markings.

BIBLIOGRAPHICAL NOTICES.

Principles of Geology, or the Modern Changes of the Earth and its Inhabitants considered as illustrative of Geology. By Sir Charles Lyell, Bart., M.A., F.R.S. Tenth and entirely revised Edition. In two Volumes, 8vo. Vol. i. 1867; vol. ii. 1868.

Siluria. A History of the Oldest Rocks in the British Isles and other Countries; with Sketches of the Origin and Distribution of Native Gold, the General Succession of Geological Formations, and Changes of the Earth's Surface. By Sir R. I. Murchison, Bart., K.C.B., &c. &c. &c. [Third Edition.] Fourth Edition including the 'Silurian System.' With Geological Map and numerous Illustrations. 8vo, 1867.

Acadian Geology: the Geological Structure, Organic Remains, and Mineral Resources of Nova Scotia, New Brunswick, and Prince Edward Island. By J. W. Dawson, M.A., LL.D., &c. &c. &c. Second Edition, revised and enlarged; with Geological Map and numerous Illustrations. 8vo. London, 1868.

We have before us three new and greatly enlarged editions of important geological works, of which geologists may well be proud, as showing the advance of the science and the manner in which first-class writers can and do treat of it, and of which geologists also assuredly make every-day use, both at home and abroad, in the cabinet and in the field. One of these noble works is purely philosophical, giving the principles on which the science is founded; the others magnificently and in detail show the application of these principles in the study of the structure, history, and capabilities of large portions of the globe.

All geologists know the value of Lyell's 'Principles of Geology,' the object of which is well expressed in its title—namely, to elucidate the causes and history of those changes on the earth's surface that have been, by a careful study and full exposition of the changes we can now recognize as taking place in both the organic and the inorganic world. Without this idea of the continuous and similar, but ever-varying, operations of natural agencies, the Philosophy of Geology would be wanting in its leading principle. In Sir Charles's own words, "The 'Principles' treat of such portions of the economy of existing nature, animate and inanimate, as are illustrative of geology, so as to comprise an investigation of the permanent effects of causes now in action, which may serve as records to after-ages of the present condition of the globe and its inhabitants. Such effects are the enduring monuments of the ever-varying state of the physical geography of the globe, the lasting signs of its destruction and renovation, and the memorials of the equally fluctuating condition of the organic world. They may be regarded, in short, as a symbolic language, in which the earth's autobiography is written." Besides this special subject, the work before us gives us the historical sketch of the early progress of geological knowledge, which has served as a mine for all popular writers on geology; also "a series of preliminary essays to explain the facts and arguments which lead me," says the author, "to believe that the forces now operating upon and beneath the earth's surface may be the same, both in kind and degree, as those which at remote epochs have worked out geological changes." With this principle is bound up the personal interest of this excellent and charming book. Excellent in its original plan, in its steady growth and advance through riper and riper editions, and charming in its perfect English, elegant style, and fascinating hold upon the reader. Without some legitimate bias, some special aim, the best-written book may prove merely a heavy work of reference. A thread for the necklace, a string to bind the bouquet, a persistent idea in a scientific work, connecting the collected facts and notions as a philosophic whole, is requisite

to ensure the fulness of beauty, aroma, and perfection that can be attained. The doctrine of Uniformity in the series of past changes in the animate and the inanimate world, then, is the living thought that gives completeness of form and a charming spirit to Sir C. Lyell's 'Principles of Geology.' Every phenomenon of nature with which the geologist has to do, whether great or small, commonplace or wonderful, has its character and bearings studied fully and candidly, without the superstition and bonds of antiquity, on one side, leading us back to the mythic period of geology, and without the seeming cold-heartedness of ultra-positivism, on the other; and all are made to show how long, how steadily, how ceaselessly, how perfectly the world's work has been carried on. As the chief expounder of the disputed doctrine of Uniformity, Sir Charles stands on the highest point in the field of discussion, beyond, perhaps, most of his followers; for some almost give up the hope of finding palæozoic mammals, some are weak in their belief in the absence of greater heat-agency in early times, and some begin to limit the earth's age, as a cooled globe, to a hundred million years or so; but it is well that his position should be clear to all good thinkers, if not perfectly incontrovertible; and, indeed, he fairly uses all his facts for the support of his view, without lessening their value to those who, thinking differently, have to thank him for the conscientious care and painstaking labour by which he has brought together all that bears on the subject-matter of the 'Principles,' from books, from people, and his own researches. The sources of information are indicated by many footnotes, and in the text too, or have been referred to in earlier editions; and, indeed, it must be a matter of grave consideration to a geological writer now-a-days as to the extent to which references to published notions and descriptions should be introduced in the pages of a new work, unless he is anxious to leave popular writers and compilers no excuse for their careless habit of quoting opinions and statements at second hand, from such large and leading works as that before us, and referring them to a wrong authorship, instead of going to the fountain-heads in special memoirs and journals for the adopted facts and views. To those who take up a scientific subject for the first time, it is easy to refer details, principles, and all to a favourite author, or perhaps to their only manual or book of study—anticipating the time when the science will be so far advanced that its accepted principles, formulæ, and practice will be universally applied, and pass, without reminder, as the result of the labours and thoughts of nearly forgotten men. Whilst, however, the science is still imperfect, let each geologist, be he gatherer of facts or builder of hypotheses, have the credit as well as the responsibility of his contributions to the general stock of knowledge. This is our author's practice; and hereby his work indicates the progress of modern geology among his contemporaries, as it supplies avowedly a history of geological thought and research in former times.

The author himself supplies a list of the principal additions and corrections in this the tenth edition of the 'Principles.' In vol. i., the ninth chapter, on the progressive development of organic life,

has been entirely rewritten, and the broad features of fossil faunæ, favourable to the doctrine of "progressive development" or of "progressive evolution," are fairly stated, and the probability of other data turning up in favour of "uniformity" is also insisted on, as well as "the unvarying constancy of the laws of nature," enabling us to reason "from the present to the past in regard to the changes of the terrestrial system, whether in the organic or inorganic world." The tenth, eleventh, twelfth, and thirteenth chapters are also quite new, treating of the changes of climate,—1st, as proved by reference to successive and different geological formations, 2ndly, as resulting from various geographical conditions, and, 3rdly, as possibly caused by astronomical changes, such as variations in the excentricity of the earth's orbit, changes in the obliquity of the ecliptic, and different phases of the precession of the equinoxes. Mr. Croll's suggestion as to the probable effects of a large excentricity in producing glacial epochs is fully discussed, and the question is entertained whether geological dates may be obtained by reference to the combined effects of astronomical and geographical causes. Many points illustrative of changes in the inorganic world, now in progress, are elucidated in this volume with new woodcuts, or with the description of new facts, or both. The enlargement and emendation of those chapters comprised in the second volume, and treating of volcanic phenomena and earthquakes, and of the changes of the organic world now in progress, are very extensive. Under the first-mentioned head comes the subject of upheaval and subsidence of large areas of the earth's surface, the internal condition of the earth, metamorphic rocks, &c. Under the other heading we have several rewritten chapters,—on Lamarck's theory of transmutation, Darwin's 'Origin of Species' and 'Pangenesis,' Natural and Artificial Selection (Darwin's hypothesis being fully accepted), geographical distribution of animals and plants, the extinction of species, &c. The forty-third chapter is devoted to the consideration of Man, his origin and distribution, calmly treated, and leading to the clear belief in man's uprising by progressive development from a lower stage of being, and adopting the fact of early man having been totally ignorant and barbarous.

"We are sometimes tempted to ask whether the time will ever arrive," says our veteran and thoughtful teacher (p. 493), "when science shall have obtained such an ascendency in the education of the millions that it will be possible to welcome new truths instead of always looking upon them with fear and disquiet, and to hail every important victory gained over error, instead of resisting the new discovery long after the evidence in its favour is conclusive. The motion of our planet round the sun, the shape of the earth, the existence of the antipodes, the vast antiquity of our globe, the distinct assemblages of species of animals and plants by which it was successively inhabited, and, lastly, the antiquity and barbarism of Primeval Man,—all these generalizations, when first announced, have been a source of anxiety and unhappiness. The future now opening before us begins already to reveal new doctrines, if possible more than ever out of harmony with cherished associations of thought. It is therefore desirable, when we contrast ourselves with the rude and superstitious savages who preceded us, to remember, as cultivators of

science, that the high comparative place which we have reached in the scale of being has been gained step by step by a conscientious study of natural phenomena, and by fearlessly teaching the doctrines to which they point. It is by faithfully weighing evidence, without regard to preconceived notions, by earnestly and patiently searching for what is true, not what we wish to be true, that we have attained that dignity which we may in vain hope to claim through the rank of an ideal parentage."

The nature of fossils of all sorts, from the microscopic siliceous atoms of the lowest plants to the bony remains of Man, their relations to the materials in which they are imbedded, the causes of their burial, and their distribution in agreement with the terraqueous conditions of the earth's surface at any given time, past or present, form matter enough for the always interesting chapters towards the conclusion of the work; and they have had their share of amendment and augmentation.

In fact, in this elaborate work we have a series of well written and philosophical essays on several branches of natural history, closely related one to another, to the gradual formation of the existing surface of the globe, and to its foregone changes and future modifications. This is an exhaustive work, complete, and without a rival. Elegant in style, perspicuous, and far from pretentious, this masterly book is read by many not studying geology as a science; for it gives a clear account of many natural phenomena in which Man has a deep and common interest.

Murchison's 'Siluria,' having almost as wide a circulation as the 'Principles,' is also well known to geologists, amateur and professional, though it is more technical, and treats specially of certain rock-formations and fossils. The wide extent, however, to which Silurian strata reach in the different quarters of the globe—the fullness and accuracy with which these strata and their fossils are described and delineated—the many elucidations of the bearings that these have theoretically on the philosophy of geology, on one hand, and practically on the structure and capabilities of different hills, plains, and regions, on the other, render this "unrivalled *résumé* of all that is known about the Lower Palæozoic rocks and fossils, all the world over," indispensable to many and attractive to others. It contains also a comprehensive sketch of the Upper Palæozoic formations, their history and their relationships, comprising valuable notices of the geology of several parts of Britain, Germany, &c., where such rocks abound. Moreover the interesting and practically useful subject of gold and its distribution has a very careful and comprehensive chapter devoted to it; and an essay on geological succession (showing the very gradual out-coming of the higher kinds of animals), and on the intensity of some natural operations in former times, complete this grand work. The improvements in this new edition are very extensive, and are mainly noticed in the author's preface, where, moreover, as also in the text, he takes care to enumerate as far as he can the manifold sources of information and aids to knowledge that his contemporaries have supplied him

with. Our acquaintance is enlarged now with the great and old Laurentian formations of Canada, thanks to the Geological Survey of that country, and with synchronous rocks in Scotland, Bohemia, and elsewhere, as worked out by Gümbel, Murchison himself, and others—with far more of the so-called "Primordial" fauna of the Lingulella-flags and the corresponding beds in Bohemia than formerly known, thanks to Barrande, Salter, Hicks, and others—with a clearer view of the Caradoc-Bala series and its intercalated volcanic masses, thanks to our Geological Survey—with improved notions respecting the Middle and Upper Silurian rocks and fossils, thanks to Salter, Davidson, and many others—and so forth. The clearing up of the doubt as to the real geological place of *Telerpeton Elginense*, *Hyperodapeton*, and *Staganolepis*, of the upper Sandstones near Elgin, now determined to be Triassic, is a great gain. The clear notices of the nature and relations of the palæozoic rocks of the Pentlands and of Ayrshire, by Mr. Geikie, are also highly acceptable; and the more exact knowledge of the Palæozoic rocks of the Continent, from the communications of De Prado, Collomb, De Verneuil, Kjerulf, Dahll, Barrande, Helmersen, and others—and of those of Canada and America also, by Logan, Hall, Billings, Bigsby, &c., add greatly to the value of this edition.

"Lastly," writes Sir Roderick, "after taking a general view of the history of the different races of animals which have succeeded to each other during all geological periods, I have, in the last chapter, added a brief sketch of my long-cherished convictions respecting many of the former physical and mechanical changes of the earth's surface, as contrasted with any movements which have taken place in historical times;" and well does he argue respecting the great changes the young earth suffered, as proved by the long and deep fractures, extensive dislocations, enormous reversals of crumpled strata, and vast removals of shattered rocks, that such great movements and denudations are inexplicable by reference to the modern action of common earthquakes, volcanoes, rain-wash, and wave-action; and he refers rather to such mighty operations as we have been lately reminded of by the powerful earthquake-wave of Hawaii, rolling in, 60 feet high, for a quarter of a mile, and answering, with its fatal bore, the devastating eruption of Mauna Loa.

Although these two great chiefs among geologists, Murchison and Lyell, differ in opinion as to whether the progressive advance of organic nature has been at a relatively slow or rapid rate, and whether the changes of land and sea, and all the concomitant variations of physical conditions, have taken place violently or gently, in long past periods, these are matters that little concern the actual truths of geology and the application of geological knowledge to the manifold requirements of our age. To the advance of the science and to its practical use each of these noble works is an admirable contribution and aid.

Both of the eminent geologists above mentioned are veterans, fellow-workers forty years ago, when their science was young.

Their labours, indeed, have been great and continuous since then; and not the least important portion of their work has consisted in directing and helping younger labourers in the same field of research. Among these Dr. J. W. Dawson, Principal of M'Gill University, Montreal, is eminent. In 1842 Sir C. Lyell visited Nova Scotia, giving and taking information on what he saw in the remarkable sections of coal-beds &c. in the Bay of Fundy and elsewhere, and putting Mr. Dawson and others on the right track towards elucidating the geology of their Province. Great results have followed. Year by year new observations were made, authenticated, and published, chiefly in the 'Journal of the Geological Society of London,' until, a few years since, Dr. Dawson published his 'Acadian Geology;' and now, with greatly increased material, collected and made known by himself and others, he has brought out what is rather a new work than a new edition, so much enlarged, enriched, and so much more complete is the present thick volume of nearly 700 pages.

Acadia or Acadie is the old and beautiful name, derived from a Micmac (native Indian) word meaning the "place" or "place of abundance," applied by the early French colonists to what is now known as Nova Scotia, New Brunswick, and the neighbouring islands; and, distinct in its natural arrangement and produce from Canada on the one hand, and from the United States on the other, this water-cut region deserves its special and appropriate name. So the author thinks, and he cordially hopes the name Acadia will live, and that the region will in the end assert its natural preeminence. A general account of the Acadian provinces is followed by a description of the deposits of the modern period, including submarine forests, remains of prehistoric man, and other interesting matters—showing how rapidly some of the changes of the surface, due to alterations of drainage and burning of forests, may have taken place. The Boulder-clay and other deposits of the Glacial period, with the remains of *Mastodon* &c., are next noticed and illustrated. These lie on the Triassic rocks, which, with their trap-rocks, useful minerals, fossil plants, and reptilian remains, are fully treated of. After noticing the Permian blank, Principal Dawson takes up the Carboniferous period and its wondrous accumulation of fossil fuel and other deposits, with its minerals, physical characters, and its fossils both of animal and vegetable origin. Eleven chapters are not too much for this rich subject, on which the author has devoted many years of labour and acute research, and from which he has extracted a vast store of information, both for palæontologists in particular and for geologists at large. He has reconstructed several of the strange trees and plants of the period, and brought together the shattered remnants of many reptiles, with two kinds of land-shells and a centipede. But these are already known to reading geologists. The Devonian rocks in this portion of the American continent are richer in plants than those of Europe and Britain; and several insects, too, as well as plants, have been discovered in them by the geologists of New Brunswick. Dr. Dawson's remarkable plant, the *Psilophyton*, is mainly of Devonian age, though some older fragments

of it are found in the Upper Silurian. The Silurian, Huronian, and Laurentian rocks are also found in Acadia, and have been elucidated by Dr. Honeyman, Mr. Hartt, and others. The economic geology of the region is kept well to the fore, also its physical geography and agricultural characteristics, as dependent on its geological structure. Many subjects of great interest in general geology are illustrated or described in this volume, especially the nature of coal, the flora of the coal, preservation of erect trees, origin of gypsum, life in seas, estuaries, &c., trails, rain-marks, and footprints, albertite, gold, primeval man, &c. Upwards of 270 woodcuts, mostly excellent in character, a good geological map, and, lastly, several lists of contents, special subjects, and illustrations, a valuable appendix, and useful index complete this satisfactory, well-written, and well-printed work on the geology and geological resources of Acadia. These large and varied provinces possess enthusiastic enlightened geologists, and furnish fields as rich for their research as the unprecedented supply of gold which Nova Scotia offers to the miner. It must be a mutual satisfaction to our Acadian brethren and ourselves to have at command this handsome and elaborate *résumé* of all that is known of the geology of that important region.

PROCEEDINGS OF LEARNED SOCIETIES.

ROYAL SOCIETY.

June 11, 1868.—Lieut.-General Sabine, President, in the Chair.

"On the Osteology of the Solitaire or Didine Bird of the Island of Rodriguez, *Pezophaps solitaria* (Gmel.)." By Alfred Newton, M.A., Professor of Zoology and Comparative Anatomy in the University of Cambridge, and Edward Newton, M.A., Auditor-General of Mauritius.

The Solitaire of Rodriguez was first satisfactorily shown to be distinct from the Dodo of Mauritius (*Didus ineptus*) by Strickland in 1844, from a renewed examination of the evidence respecting it, consisting of the account given by Leguat in 1708, and of the remains sent to France and Great Britain. Strickland, in 1848, further proved it to be generically distinct from the Dodo. The remains existing in Europe in 1852 were eighteen bones, of which five were at Paris, six at Glasgow, five in the possession of the Zoological Society (since transferred to the British Museum), and two in that of Strickland, who, at the date last mentioned, described them as belonging to *two* species, the second of which he named *Pezophaps minor*, from the great difference observable in the size of the specimens. In 1864 one of the authors visited Rodriguez, and there found in a cave two more bones, while a third was picked up by a gentleman with him. All these bones have been described, and most of them figured, in the publications of the Zoological Society, and in the large work of Strickland and Dr. Melville *.

* The Dodo and its Kindred. London: 1848, 4to.

Encouraged by his former success, that one of the authors of the present paper who had before been to Rodriguez urged Mr. George Jenner, the magistrate of the island, to make a more thorough search in its caves ; and in 1865 this gentleman sent no less than *eighty-one* specimens to Mauritius. These were forthwith transmitted to London, and exhibited at a meeting of the Zoological Society in that year, when it appeared that the notion previously entertained of there having been two species of *Pezophaps* was erroneous, and that probably the difference in size of the specimens was sexual.

News of this last discovery reached England during the meeting of the British Association at Birmingham, and, prompted by Mr. P. L. Sclater, that body made a liberal grant to aid further researches. Owing to several causes, the scarcity of labourers in Rodriguez being the chief, nearly a year elapsed before these could be begun. But in 1866, some coolies having been expressly sent thither to dig in the caves, a very large collection of the bones of this bird, amounting to nearly *two thousand* specimens, was obtained. These specimens include almost all the most important parts of the skeleton, and furnish the authors with the material for the present paper.

This vast series of specimens shows that there was a very great amount of individual variability in the bird, so much so as to render the task of describing them minutely, and yet generally, a very difficult one. Yet, in consequence of this wealth of material, the authors have greater confidence in the opinions they declare. Professor Owen, having lately published a very detailed account of the osteology of the Dodo *, the present paper follows as closely as possible the mode of treatment he therein adopted, the authors thinking that they are so consulting the convenience of those who may wish to compare the structure of the two allied birds. Thanks to him, also, they have been able themselves to examine the very specimens which he described ; and they are further indebted to many others —Mr. George Clark of Mauritius, Professors Reinhardt, Fritsch, and Alphonse Milne-Edwards, Sir William Jardine, and Mr. Flower, for valuable assistance in the shape of models or other additional material. To Mr. J. W. Clark they also mention their obligations for reconstructing from specimens in their possession the skeletons of the Dodo and of two Solitaires now exhibited.

The description of the latter follows in much detail, the amount of individual variability to which each bone was subject being specially dwelt on, and the whole compared bone by bone with that of the Dodo and also of *Didunculus*. *Pezophaps* differs from *Didunculus* quite as much as *Didus* does, but it is nearly allied to the latter. Still there are important differences. The neck was much longer than in *Didus*, and the vertebræ, on the whole, larger. The ribs also possess perhaps somewhat thicker heads and articular tubercles. The pelvis is much more rounded, and approaches that of

* "On the Osteology of the Dodo (*Didus ineptus*, Linn.)," Trans. Zool. Soc. vol. vi. pp. 49–85.

the normal Pigeons much more than that of *Didus* does; but in its posterior portion it differs very remarkably from that of any known bird; for the pubis in *Didus* has not yet been discovered. In the sternum *Pezophaps* generally agrees with *Didus*, but has some distinctive features. This bone shows articular surfaces for four sternal ribs only, instead of five, which seems to be the normal number in *Didus*; and the posterior extremity, so far as can be judged from the imperfect condition of the specimens, is very unlike what it is in that bird; but the characters deducible from this last portion in birds generally are shown to be very inconstant. The "scapular arch" differs from that of *Didus*, its constituent portions having been apparently never anchylosed as is the normal state there, and consequently resembling in this respect those of the generality of birds. The angle made by the junction of the coracoid and scapula cannot be accurately determined, but would appear to have been not much less than what it is in *Didus*. The scapula is of very peculiar form, unlike, so far as known to the authors, that of any bird, being inclined somewhat forward, and only pointing backward at its extremity, where it becomes spatulate in shape. The coracoid exhibits, as usual in this very significant bone, some good diagnostic characters. It is much stouter than it is in *Didus*—a fact not so surprising when the exceedingly abnormal form it there assumes is taken into consideration. At its sternal end it differs from that of most other birds, in the extension and rounding off of the outer border. Other peculiarities in it are also described, one of which appears to be sexual. This is the surface to which the scapula is articulated, and which in the large individuals (presumed to be males) is roughly quadrate, while in the smaller ones (the supposed females) it is triangular. In *Pezophaps* the bones of the wing are more massive and smoother than in *Didus*, judging from such remains of the latter as exist. The most remarkable thing about them, however, is the presence of a bony knob on the radial side of the metacarpal, unlike what is found in any other bird. It is large in some of the specimens, supposed to have belonged to old males, but very little developed in the presumed females. It is more or less spherical, pedunculate, and consists of a callus-like mass with a roughened surface, exceedingly like that of diseased bone, and was probably covered by a horny integument. It is situated immediately beyond the proximal end and the index, which last would appear to be thrust away by it to some extent. It answers most accurately and most unexpectedly to Leguat's description of it:—"L'os de l'aileron grossit à l'extrémité, et forme sous la plume une petite masse ronde comme une balle de mousquet." A description of its structure, as ascertained microscopically by Mr. J. Gedge, is added. The extremity of the wing is wanting. The leg-bones of *Pezophaps*, when compared with those of *Didus*, show more strongly developed ridges and muscular impressions, just the converse of what is observable in those of the wing; but the leg-bones having been minutely and correctly described by prior authors, it is unnecessary here to say much of them. Part of the skull, too, had been already described; but the only

specimen then known was so incrusted with stalagmite that not much could be made of it. The present remains show that it was very markedly different in many respects from that of *Didus*. The cranium is narrower and longer, and without the peculiar frontal protuberance of *Didus*, being nearly flat at the top, with the fore and hind part elevated into two bony ridges of cancellous structure. The upper mandible also presents a remarkable difference from that of *Didus*, where the axes of the nasal process and the maxillary converge, whereas in *Pezophaps* they diverge. The maxilla also was relatively very small; and the mandible differed by being much straighter above, showing a salient angle on its lower edge (which is very inconsiderable in *Didus*), and being much more solid posteriorly. In the quadrate the two birds are more alike. The rest of the bones of the head are wanting.

A comparison of the entire skeleton shows that *Pezophaps* is in some degree, and perhaps on the whole, intermediate between *Didus* and the normal Columbæ, while it has some features, such as the armature of the wing, quite peculiar. It has no very near affinity to *Didunculus*; indeed that form must be considered the type of a separate family, though not so aberrant as the *Dididæ*, which must be looked upon as the most remotely connected of the order Columbæ. Strickland was amply justified in arriving at the conclusion that the Solitaire of Rodriguez was generically distinct from the Dodo; but it seems expedient to define his genus *Pezophaps* more precisely. Accordingly the following characters are assigned to it:—

Rostrum mediocre, curvatum, processu nasali et ramis maxillaribus antice divergentibus. Frons plana, porcâ osseo-cancellatâ circumdata. Ossa coracoidea robusta. Alæ breves, involatiles. Manus singulis bullis osseo-callosis armatæ. Collum et pedes longiores.

In like manner the genus *Didus* may be defined:—

Rostrum magnum, aduncum, processu nasali et ramis maxillaribus antice convergentibus. Frons tumida, in umbonem hypoconicum osseo-cancellatum surgens. Ossa coracoidea attenuata, scapulas obtuse attingentia. Alæ breves, involatiles. Manus inermes. Collum et pedes breviores.

The account given by Leguat of his Solitaire is then quoted in full, as also that of d'Heguerty, the latter from Strickland, and the authors proceed to remark upon the different causes of extinction of species within historic time. This, when effected by man's agency, is seldom done by man's will; and various cases are cited to support this opinion. In extirpating species man generally acts indirectly; and they succumb to forces set in motion indeed by him, but without a thought on his part of their effect. In the case of the extinction of the Solitaire of Rodriguez, the cause usually suggested seems inadequate; and the authors consider it was probably effected by feral Swine, and quote a remarkable passage from an old French Voyage, showing the extraordinary abundance of these creatures in Mauritius, where, in or about the year 1708, above *fifteen hundred* had been slain in one day. It is plain that where these abounded

inactive birds could not long survive. It is supposed that the case was the same in Rodriguez as in Mauritius; for in every country newly discovered by Europeans, it has been an almost universal custom to liberate Pigs, and there is no reason to believe that the island first named was an exception thereto.

The extraordinary fidelity of Leguat's account of the Solitaire is next considered. It is borne out in every point save one, perhaps, by a study of the remains. The rugose surface at the base of the maxilla, the convexity of the pelvis, the somewhat lighter weight of the Solitaire than of the Dodo, its capacity for running, and, above all, the extraordinary knob on the wing, all agree with the description he has given us. The authors attempt also to account for the origin of this last by observing that its appearance is so exactly that of diseased bone, that it may have been first of all occasioned by injuries received by the birds in such combats with one another as Leguat mentions, and aggravated by the continuance of their pugnacity. The authors remark, also, that it is the habit of Pigeons to fight by buffeting with their pinions.

The particular in which Leguat may have erred is in the assertion, or perhaps rather inference, as to the monogamous habits of the Solitaire; and the cause of the error (if such it be) may be ascribed, without derogating from his truthfulness, to his anxiety to point a moral, which may have led him to imagine he saw what he wished to see. He especially mentions that one sex would not fight with the other, which is just what takes place among polygamous birds. The case of a very well-known bird (*Otis tarda*), about which much has been written, is then cited, to show that even now, after centuries of observation, it is doubtful whether it be monogamous or polygamous. Leguat, therefore, may easily have been mistaken in his opinion, even setting aside his evident leaning on the matter. The notion of *Pezophaps* having been polygamous was before entertained by one of the authors, and arises from a consideration of the great difference in the size of the two sexes, which in birds is generally accompanied by polygamous habits; but the question is now not likely to be solved.

The amount of variability which every bone of the skeleton of this species presents, warrants the conclusion that as much was displayed in those parts of its structure which have perished, letting alone Leguat's direct evidence as to the individual difference in the plumage of the females. If such a process, therefore, as has been termed "Natural Selection," or "Survival of the Fittest," exists, there would have been abundant room for it to operate; and there having been only one species of *Pezophaps* might, at first sight, seem an argument against the belief in such a process. A little reflection, however, will show that such an argument is unsound. Confined in a space so restricted as one small island, every individual of the species must have been subject to conditions essentially identical in all cases. Whatever power such a process might possess, there would be neither occasion nor opportunity for its operation, so long as no change took place in the physical character of the island.

But if we venture to indulge our fancy, and consider what would have been the inevitable result of a gradual upheaval of the island, and a corresponding extension of its area until it became vastly increased and its original low rounded hills were exalted into mountains, it is plain that a great variety of physical conditions would be thereby incurred. One side of the island would be exposed to the full force and direct influence of the trade-winds, the other side would be completely sheltered from them. The climate of these two portions would accordingly differ, and a great difference would be speedily wrought in the character of their vegetation, while that of the elevated central part would undergo a corresponding modification. After some longer or shorter period, we can conceive the island itself being broken up into two portions, separated from one another by a strait, such as divides the North and Middle Islands of New Zealand. This rupture would certainly tend still more to affect the existing fauna and flora; and at the end of another epoch there can be little doubt that the animals and plants of each portion, exposed to different influences, would present a decidedly different appearance, and the eastern and western islands (supposing the separation to have taken place in the direction of the meridian) might each possess its own special form of Solitaire, as the islands composing New Zealand have their peculiar species of *Apteryx*.

But it is only in such a case as has just been imagined that considerable modifications would be likely to be effected. It therefore seems to be no argument against the existence of such a process as that of "Natural Selection," to find a small oceanic island tenanted by a *single* species which was subject to great individual variability. Indeed a believer in this theory would be inclined to predicate that it would be just under such circumstances that the greatest amount of variability would be certain to occur. In its original state, attacked by no enemies, the increase of the species would only be dependent on the supply of food, which, one year with another, would not vary much, and the form would continue without any predisposing cause to change, and thus no advantage would be taken of the variability of structure presented by its individuals.

On the other hand, we may reflect on what certainly has taken place. Of the other terrestrial members of the avifauna of Rodriguez but few now remain. A small Finch and a Warbler, both endemic (the first belonging to a group almost entirely confined to Madagascar and its satellites, the second to a genus extending from Africa to Australia), are the only two land-birds of its original fauna now known to exist. The Guinea-fowl and Love-bird have in all probability been introduced from Madagascar; but the Parrots and Pigeons of which Leguat speaks have vanished. The remains of one of the first, and the description of the last, leave little room to doubt that they also were closely allied to the forms found in Madagascar and the other Mascarene islands; and thus it is certainly clear that *four* out of the *six* indigenous species had their natural allies in other species belonging to the same zoological province. It seems impossible on any other reasonable supposition than that of a common

ancestry to account for this fact. The authors are compelled to the belief that there was once a time when Rodriguez, Mauritius, Bourbon, Madagascar, and probably the Seychelles were connected by dry land, and that that time is sufficiently remote to have permitted the descendants of the original inhabitants of this now submerged continent to become modified into the many different representative forms which are now known. Whether this result can have been effected by the process of "Natural Selection" must remain an open question; but that the Solitaire of Rodriguez, and the Dodo of Mauritius, much as they eventually came to differ, sprang from one and the same parent stock, seems a deduction so obvious, that the authors can no more conceive any one fully acquainted with the facts of the case hesitating about its adoption than that he can doubt the existence of the Power by whom these species were thus formed.

MISCELLANEOUS.

Note on the Existence of a large Pelican in the Turbaries of England. By A. Milne-Edwards.

We know very little about the birds of which the remains are found in turbaries, and hitherto their precise determination has never been attempted. There would nevertheless be much interest in such an examination, and in seeking what species of this class inhabited our countries at the period when the beaver, the urus, the aurochs, and the gigantic stag lived in great numbers in the forests and on the banks of the watercourses. I have recently been able to convince myself that investigations of this kind may furnish important results.

The turbaries of the neighbourhood of Cambridge have furnished a considerable number of the bones of birds, which Mr. Seeley and Prof. Alfred Newton have been kind enough to submit to my examination. I was astonished to find among these remains the bone of a pelican. This bone, which belongs to the Woodwardian Museum, was obtained from the turbaries of the marshy districts (fenlands) which cover the northern parts of the county of Cambridge. These deposits have been studied with much care by Mr. Seeley, who, with his usual obligingness, has furnished me with valuable information upon the subject.

Beneath peat in course of formation, of variable thickness, and containing some freshwater shells and existing plants, there is a clay filled with marine shells and containing some remains of marine mammalia. This clay rests upon a bed of peat in which the trunks of trees are met with, some of them still placed vertically. It is in this layer that the bones of terrestrial animals occur; and although the exact position where the humerus of the pelican was collected was not noticed, its colour and nature prove that it is derived from this peaty deposit. The mammalia indicated as occurring in it belong to the following species:—*Bos frontosus*, *B. primigenius*, *Cervus megaceros*, *Ursus arctos*, *Lutra vulgaris*, *Canis lupus*, *Cervus*

elaphus, *C. capreolus*, *Sus scrofa*, and *Castor europæus*. Finally, I have been able to recognize several species of birds, such as the swan (*Cygnus ferus*), the wild duck (*Anas boschas*), the teal (*Anas querquedula*), the crested grebe (*Podiceps cristatus*), the bittern (*Ardea stellaris*), and the coot (*Fulica atra*). These birds still occur in great abundance on the east coast of England. Their presence in the turbaries, therefore, cannot surprise us; but this is not the case with the pelican, which does not belong to the British fauna; for the few individuals which have been met with there had been carried by the winds very far from the regions which they usually inhabit. Now the existence of our pelican in the peaty deposits of Cambridge cannot be explained in this way. The bone in question is derived, in fact, from a young bird, consequently too weak to undertake a distant journey. A glance at the fossil the history of which I am giving is sufficient to prove that the work of ossification was not completed, as is indicated by the state of the articular extremities. We cannot, therefore, think for one moment that this bird has quitted Africa or the south of Russia, and, being turned from its course by atmospheric currents, has come to die in England upon the edge of the marshes in which the peaty layers in which it was discovered were being deposited. Such an explanation as this is inadmissible; and this pelican was evidently a native of that country.

The humerus here referred to is of very considerable dimensions. Its articular extremities are imperfect; it is not, therefore, entire, and evidently with increased age it would have become considerably elongated. Nevertheless it measures about 37 centimetres. Knowing the length of the arm-bone, we may easily deduce from it that of the entire wing; for in the pelicans the proportions of the various bones which form the solid framework of the anterior limb vary very little. Thus, if we represent the length of the humerus of these birds by 100, that of the forearm would be 113, and that of the hand 78. Consequently, assuming that in our pelican from the turbaries the proportions of these bones were the same, the forearm would have measured 42 and the hand 29 centimetres, which brings the whole length of the wing without its feathers to 1·08 metre.

I have compared the fossil from the Cambridge turbaries with several arm-bones of adult pelicans belonging to different species, such as *Pelecanus onocrotalus*, *P. crispus*, *P. philippinensis*, and *P. thagus*, but I have not found one the dimensions of which were the same; even the largest *onocrotali* scarcely approach it. Must we therefore regard the bird from the turbaries as a distinct species, of larger size? This supposition seems a very probable one; but it would perhaps be premature to attempt at present to establish a new specific type; and before inscribing it upon our scientific catalogues, it seems to me that it will be more prudent to wait until further researches have led to the discovery of some parts of the skeleton of adult birds, which may make known to us more accurately the proportions of our British pelican.—*Comptes Rendus*, June 22, 1868, pp. 1242–1244.

On Oliva auricularia, *Lam.*, O. aquatilis, *Reeve, and* O. auricularia, *D'Orb.* By F. P. Marrat.

The history of these shells is somewhat remarkable—so much so that each author who has written upon them has had some information to impart of a character differing considerably from that of his predecessor.

Lamarck described a species which he called *O. auricularia* (Animaux sans Vertèbres); the former part of this description refers to the *O. aquatilis*, Reeve, pl. 18. fig. 38, while the latter ("columella callosa, complanata") refers to the *O. auricularia*, Lam., as figured by Reeve, pl. 18. fig. 39.

D'Orbigny (Voy. Amér. Mérid. vol. ix. pl. 59. figs. 20–22) has figured a shell, accompanied by the animal, and named it *Olivancillaria auricularia*, Lam., from which species it differs so much as to be regarded as even generically distinct. Deshayes, in a footnote to the description of *O. auricularia*, Lam., remarks that D'Orbigny has confounded his shell with Lamarck's species, and considers D'Orbigny's species to be *O. biplicata*, Sow., quoting the figure in Wood's Supplement. Again, this author, under the species *O. biplicata*, Sow., gives D'Orbigny's *O. auricularia* as a synonym, and describes the difference existing between the two species. In the Tankerville Catalogue, page 33, Appendix No. 2331, we have a description of the two species under the name of *O. patula seu aperta*, Sol. MS., the former portion of this description referring to the *O. auricularia*, Reeve, or the thick African species, and the latter portion to the *O. aquatilis*, Reeve, or the thin South-American shell.

Duclos (Genre *Olive*, pl. 29. figs. 4–7) has not only figured the two shells hitherto confounded under the *O. auricularia*, Lam., but has introduced two figures of another allied species or variety (pl. 29. figs. 5 & 6).

Reeve, in his 'Monograph on the genus *Oliva*,' in 1851, separated the shells into two species, viz. *O. auricularia*, Lam., and *O. aquatilis*, Reeve, but gave a wrong locality to the former, viz. Brazil instead of Africa. The Messrs. Adams, in their valuable work on the 'Genera of Recent Mollusca,' vol. i. pp. 140 & 141, give a description of the genus *Olivancillaria*, D'Orb., and figure at pl. 15. fig. 2 a copy of D'Orbigny's animal and shell, with the name *O. vesica*, Gmelin. On the same plate, fig. 2ª, *O. auricularia*, Reeve, is given as the shell of D'Orbigny, the first having an open canaliculate spire, and the second a closed canal; in fact two species could scarcely be selected that differ more widely. Dr. Gray, in his work on the Olividæ, p. 19, gives the *Claneophila auricularia*, Lam., as the *O. aquatilis*, Reeve, and *O. patula*, Sow., as a synonym, and to the thick African shell he has given a new name, *Cl. gibbosa*, Gray.

What inferences can we draw from these contradictory statements? First, that the *O. vesica*, Gmel., is the *O. auricularia*, Lam., in part, as well as the *O. patula*, Sow., in part, and of Duclos in part, these authors all believing that the *O. aquatilis*, Reeve, was only a variety of *O. auricularia*, Lam.; and the credit of distinguishing them as species

is due to Reeve. I suppose we shall have to record the *O. aquatilis*, Reeve, as the *O. auricularia*, Lam., unless we should find a figure of this shell in some early work under another name.

The only shell remaining is the *O. auricularia*, D'Orb. Both Deshayes and Duclos are of opinion that D'Orbigny made some mistake: I am of quite the contrary way of thinking. We have the animal and shell given, the latter differing essentially from the *O. auricularia*, Lam.; and D'Orbigny might easily have thought it might belong to that variable species, as it was then supposed to be. I cannot think that such a naturalist as D'Orbigny would figure an animal and put an imaginary shell upon it; and therefore I conclude that the shell figured is the one dredged, and no other. Having arrived at this conclusion, and having carefully compared the shell figured with *O. biplicata*, Sow., there is no doubt in my mind of its being entirely new. In the first place, its open spire is sufficient to prevent its being mistaken for *O. auricularia*, and it differs from *O. biplicata* in not being biplicate but multiplicate, in not having the violet interior and basal band, and in having the basal band spotted —characters by which it may at once be distinguished from that species.

I think the species might be named after its discoverer, *O. Orbignyi*.

2 Peveril Terrace, Edge Lane, Liverpool.
July 17, 1868.

On a Viviparous Sea-Urchin. By Dr. E. Grube.

Our knowledge of the sexual conditions, reproduction, and development of the Sea-Urchins hitherto extended only to the fact that there are produced from the fecundated ova bilateral free-swimming larvæ furnished with lines of cilia (*Pluteus*), and that internal buds are formed in these, and become developed, in accordance with the 5-rayed type, with a spiny test and feet, into sea-urchins, which acquire male or female genitalia. The semen and ova issue through several small apertures situated at the summit of the test near the madrepore-plate.

The little Sea-Urchin upon which I have the honour to report to the Academy enlarges our knowledge of the natural history of the Echinoida by a very singular character: it produces living young, which are already sea-urchins, provided with test, spines, and feet, and so large that their diameter is more than one-tenth of the length of the parent animal, to which I give the name of *Anochanus*.

In its appearance *Anochanus* most closely resembles the *Nucleolites* (*Echinobrissus*) *epigonus* lately described by Dr. von Martens; it has an oval test, not broader behind, of 9·5 millims. in length, with a pit descending in the hinder interambulacrum, in which the anus opens, and a subventral peristome of elongate-oval form; but the feet run in uninterrupted rows from the peristome to the summit, which nearly occupies the middle. But the most peculiar circumstance is that we seek in vain for genital openings and a madrepore-

plate at the summit, which, however, contains an orifice of considerable size, concealed by overlying spines. This orifice does not lead into the cavity occupying the whole inner space of the test, but into a peculiar sac spread out beneath the dorsal arch, which does not seem to communicate with the general cavity, and in which the above-mentioned little sea-urchins lie; so that they can make their escape through the opening, which corresponds with them in diameter. The walls of this sac are formed by a membrane filled with a microscopic calcareous latticework; this is applied to the margins of the orifice, which are broadly turned inwards, and is thus suspended. Upon the inner surface of the sac small *Pedicellariæ* are seated, and upon the inner surface of the above-mentioned incurved margins small spines; upon the surface of the test, besides the spines, *Pedicellariæ* of larger dimensions occur; and the spines (which, however, do not appear to the eye to form rows) are of two kinds—namely, longer ones, which are not very sharp, and shorter ones spreading at the end into small teeth.

The internal space of the test, situated beneath the sac destined for the reception of the young, is chiefly occupied by the intestinal canal, which is attached to the wall, and commences with a very narrow œsophagus: on the anterior part of the wide portion, in which this is immersed, and which perhaps may be indicated as a stomach, a spot beset with minute paired cæca may be observed. A very fine and rather rigid canal, descending from the bottom of the brood-sac and probably continued to the region of the peristome, may perhaps be the sand-canal, and the spot from which it originates the madrepore-plate. But no trace of genitalia is to be seen, which is in accordance with the want of genital apertures. The germs of the young must be produced on the lower surface of the brood-sac; for here are suspended oval corpuscles about $\frac{3}{4}$ millim. in length, closely embraced by a saccule, which greatly resemble the youngest spineless embryos in the brood-cavity, whilst the most developed of the latter, as already stated, possess a test with feet and spines, and even with *Pedicellariæ*. Nevertheless these young animals do not present any complete agreement with the parent animal: their test is circular in its horizontal circumference, the peristome central, the larger spines distinctly stand in two longitudinal rows upon the interambulacra, and, above all, they want the apical orifice and the pit for the anus, although a spot free from spines may be observed upon the back of the test a little behind the middle.

According to this representation (which, indeed, is founded only upon the investigation of a single specimen) these germs, which are seated upon the calciferous walls of a sac opening outwards with a wide orifice, would have to be regarded as buds, and *Anochanus* as a young or larval state, like a *Pluteus*; but the young which it produces must await a sexual development.

However, it is permissible, and will facilitate future comparisons, to give the animal on which these investigations have been made a distinct name; and as, according to the statement of Salmin, the natural-history dealer, it was found in the Chinese Sea, it may be

provisionally cited as *Anochanus sinensis.—Monatsber. Berl. Akad. Wissensch.* March 12, 1868, pp. 178–180.

Note on the Anatomy of Pontobdella verrucata (*Leach*).

By L. Vaillant.

The number of rings in the zoonite in *Hirudo* and most of the allied genera is 5; in *Pontobdella* it is 4, as was recognized by Savigny. The body of *P. verrucata* contains 10 complete zoonites in its middle part, behind the cincture; the extremities and the cincture are less regularly formed, the rings being often grouped in threes. The total number of rings is 66. In the male zoonites (the six immediately following the cincture) the testes occupy the first ring, the nervous ganglion is placed between the third and fourth, and upon the last are the muciparous pores.

Beneath the skin and muscles the body presents a thick layer of yellowish-brown glandules, the excretory canals of which may be traced to the surface; they probably endue the animal with a protective coat. The muciparous vesicles of the cincture present a ciliated inner pavilion analogous to that indicated first in the Lumbricina, and afterwards in the *Branchiobdellæ*.

The trunk, by which these worms suck the blood which constitutes their food, is quite unarmed, so that it probably only penetrates by separating the tissues. The œsophagus is surrounded by whitish glandules, the excretory ducts of which are directed forward, towards the anterior disk. An analogous arrangement has been indicated in *Aulastoma* by Leydig, who supposes that these glands discharge themselves at the jaws to facilitate their action; the author thinks that they have probably to do with the formation of the oviferous cocoon. The so-called *stomach*, which the author would prefer to name *ingluvies* or *crop*, is a reservoir in which the blood accumulates without undergoing any perceptible change. It is divided anteriorly into seven chambers, indicated outside by slight constrictions, and separated by incomplete septa; behind is a large cæcum to which the intestine is applied longitudinally. The intestine has two lateral dilatations at its origin, and is divided into four nearly equal parts. The walls of the ingluvies are formed by interlaced fibres of laminar tissue and smooth muscular fibres, without distinct glandular elements; the walls of the intestine contain a multitude of true *glandular acini*. It is here that the process of digestion commences.

The female generative apparatus consists of a long sac or cæcum, the anterior neck-like part of which terminates at a whitish body of glandular aspect. From this starts a duct which unites with that of the opposite side, to open by a single median aperture. The glandular organ likewise receives from five to seven ducts on its inner surface; and these the author believes come from the transparent glands which occur at some parts, mixed with the yellowish subcutaneous glandules. This system would then have to be re-

garded as a diffused vitellogene, analogous to that indicated in other Cotylide worms.

The *Pontobdella* envelopes its ovum in a cocoon fixed by a pedicle to submarine bodies; this is figured by Hesse and Van Beneden, but from an altered specimen, unless it belongs to a different species. The animal embraces the cocoon with its anterior disk to complete and fix it. Hence, and from the facts observed in other species, the author concludes that the so-called salivary glands furnish the material for this protective envelope of the ova.—*Comptes Rendus*, July 13, 1868, pp. 77–79.

Considerations upon the fixation of the limits between the Species and the Variety, founded upon the study of the European and Mediterranean species of the Hymenopterous Genus Polistes (*Latr.*). By M. Sichel.

I. For several years the question of the mutability or immutability of the species has been afresh brought under discussion, and vividly attracts the attention of zoologists. Nothing can contribute more to exhaust this question and to pave the way to its solution, by aiding powerfully to fix the limits between the species and the variety, than the profound study and exact statistics of certain genera of insects richly represented in individuals, and possessing a sufficient number of species common in our climates to allow us to study them on a large scale in regular and complete series. Series captured in the nests especially, by permitting the comparison of allied species and the exact observation of the transitions between each species and its varieties, will singularly facilitate our conclusions, and give them a high degree of certainty.

Such a genus is the Hymenopterous genus *Polistes*, represented in the whole of Europe, in Algeria, and in the western part of Asia by four species (three of which are very common even in the environs of Paris), viz. *P. gallicus*, *biglumis*, *diadema*, and *Geoffroyi*.

II. But these last three species are identical with *P. gallicus*, and only differ from it as varieties. It is this opinion that I endeavour to establish here by numerous and, I think, convincing proofs, in order to show for once how the study of the Hymenoptera on a large scale and on the living animal may contribute to fix the limits between the species and the variety.

III. The above four species may be well characterized; but their diagnostic characters are neither constant nor essential, as is proved by the following propositions, deduced from long-continued and accurate observations:—

1. The subvarieties are so numerous that we may at pleasure create new varieties among them.

2. The transitions between the different varieties are so frequent and so insensible that it is often impossible to say where one variety or subvariety ends, and where the next one commences.

3. In the same nest we see hatched simultaneously or successively

the different varieties and subvarieties, especially *P. gallicus*, *biglumis*, and *Geoffroyi*, with all the passages from one to the other.

4. Among the numerous individuals of *P. biglumis* that I have captured or bred from nests, I have never been able to find a female. The females revert more or less to the characters of *P. gallicus*, or are replaced by the female of the latter.

5. Nor does the male of *P. biglumis* exist; it always, more or less, presents the characters of *P. gallicus*.

6. From this it follows that *P. biglumis*, according to the most accurate observation made upon large series and numerous nests, is only a peculiar modification, a variety, of *P. gallicus*.

IV. Observations upon the exotic species of *Polistes* lead to perfectly analogous conclusions.

V. To sum up, the exact and serial observation of the genus *Polistes* serves marvellously to prove that the mutability of the species, in zoology, although very great as to its varieties, does not extend beyond these, and does not attain to the production of specific types when these are well defined and correctly established.—*Comptes Rendus*, July 13, 1868, pp. 75–77.

On a new Species of Chirogalus *from the West Coast of Madagascar.* By M. A. Grandidier.

Chirogalus Samati (nob.). Obscure fusco-griseus, subtus fulvescens. Cauda crassa, obsolete rufescente; fascia alba a fronte media ad nasi apicem decurrente; oculis nigro circumdatis; auriculis paulo longioribus quam *Chirogali Milii*.

Long. ab apice nasi ad caudæ basin 19 centim.; caudæ 17 centim.

Habitat flumen Tsidsibon, in littore occidentali Madagascar insulæ.

This *Chirogalus* is specially remarkable by its head, which resembles that of a young cat, and by the size of its tail, which is 6 centimetres in circumference; it owes this size, which is abnormal in the Lemurids, to the presence of a thick layer of fat, similar to what occurs round the tails of the Cape sheep.

The hair of the body, as well as that of the tail, is rather short. It is known to the natives by the name of Kéli-bé-houï.

I have named this animal after M. E. Samat, who has resided for the last twenty-two years on the west coast of Madagascar, and from whom I have received great kindness during my stay in these inhospitable regions. To him I owe my acquaintance with this curious Lemurid and the two specimens which I have forwarded to the Paris Museum.

I avail myself of this occasion to make known a curious fact which the beautiful collections recently brought from the north-west coast of Madagascar by the skilful keeper of the Musée de Bourbon, M. Lantz, have enabled me to verify, viz. that *Berniera major* and *Berniera minor* are but one species: *B. major* is the male, *B. minor* the female. M. Lantz has taken some fifteen of each animal in the same locality, and ascertained that they lived together.

Saint-Denis, Ile de Réunion, Dec. 18, 1867.

Ann. des Sciences Nat. viii. p. 294.

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XV.—*On the British Species of* Alpheus, Typton, *and* Axius, *and on* Alpheus Edwardsii *of Audouin.* By the Rev. A. M. Norman, M.A.

In the 'Annals' of the present month Mr. Spence Bate records and figures two Macrourous Crustacea as new to our fauna, under the names of "*Alpheus Edwardsii*" and "*Typton spongiosus*." The former species, however, is so far from being hitherto unknown in our seas, that this is the *third* time that it has been announced as a new discovery; and the Crustacean here called *Typton spongiosus* was described and figured by Mr. Couch, in 1861, as "*Alpheus Edwardsii*." It seems strange that Mr. Bate should not have known this, as the species was found in his own neighbourhood, and, moreover, Mr. Couch is one of the members of the Devon and Cornwall Dredging Committee.

I should not, however, have considered it necessary to notice this, if it had not been that the greatest confusion exists as to what "*Alpheus Edwardsii*" is, on which account it seems desirable to make a few observations upon the genera *Alpheus* and *Typton*.

Savigny, in his 'Histoire de l'Egypte,' admirably figured a Crustacean, to which Audouin, in the descriptive portion of that work, gave the name "*Athanas Edwardsii*." Milne-Edwards, in his 'Hist. Nat. des Crustacés,' described a Mediterranean form which he erroneously considered to be Audouin's species. Lastly, Mr. Couch (Proc. Linn. Soc., 1860, Zoology, v. p. 210) described a Cornish Crustacean under the same name; but his species is neither that of Audouin nor that of Milne-Edwards, but the *Typton spongicola* of Costa. The name of *Alpheus Edwardsii* has thus been given to no less than three distinct species, two of which, as we shall presently see, occur in our seas, though the true *Alpheus Edwardsii* of Audouin is not European.

As long ago as 1835, Mr. Hailstone procured off Hastings a shrimp, which he figured and described in 'Loudon's Magazine of Natural History,' and to which Mr. Westwood gave the name of *Hippolyte rubra*; in a subsequent page, Mr. Hailstone claimed a right to name it himself, and styled it *Hippolyte megacheles*; and further on in the same volume, Mr. Westwood established a genus for its reception, calling it *Dienecia rubra*. Why Prof. Bell omitted this species in his 'History of British Stalk-Eyed Crustacea,' I cannot understand. In 1854, Mr. Guise, having found the same species in the island of Herm, described it in the 'Annals,' and named it "*Alpheus affinis*." In 1862 Prof. Heller pointed out the distinction between the Red-Sea species (*Alpheus Edwardsii*, Aud.) and that found in the Mediterranean (*Alpheus Edwardsii*, Milne-Edwards), and named the latter *Alpheus platyrhynchus*. The *Alpheus* now found by Mr. Bate off the Dodman is the Mediterranean species, and the same which had been previously taken in our seas by Hailstone and by Guise. As I write, thirty or forty specimens of this *Alpheus*, procured by me at Herm, are before me, and also a specimen of the true *Alpheus Edwardsii* of Audouin, for which I am indebted to Prof. Heller. From these examples I draw up the diagnostic characters which follow.

Alpheus Edwardsii, Audouin.

1826. *Athanas Edwardsii*, Audouin, Savigny, Descript. de l'Egypte, pl. x. fig. 1 (figures admirable).
1840 (? about), *Alpheus Edwardsii*, Guérin, Iconogr. du Règne Anim. Crust. pl. 21. fig. 3 (copy from Savigny).
1861. *Alpheus Edwardsii*, Heller*, Sitzungsb. d. k. Akad. d. W. Math.-nat. Cl. xliv. Bd. i. p. 267.

Supraorbital portions of anterior margin of carapace rounded, the front thus furnished with only a single central point, *i. e.* the rostrum. The left first pereiopod much larger, and of totally different structure from the right; outer side of hand (not furnished with any spine-like central point projecting at the junction of finger and thumb) having a deep incised curved groove widest at the distal extremity, suddenly contracting in breadth towards the base, and at the same time curving downwards; finger large, very broad and massive, the outer margin very strongly arched, forming a complete semicircle; inner margin furnished at the base with a large tubercular process, which fits into a corresponding socket in the thumb. Right hand very much smaller, and formed more after the pattern of the hand in

* Beiträge zur Crustaceen-Fauna des rothen Meeres.

Palæmon. The fingers of both hands articulating by a vertical movement with the hand.

Hab. The Red Sea.

Alpheus megacheles, Hailstone.

1835. *Hippolyte rubra*, Westwood, Loudon's Mag. Nat. Hist. vol. viii. p. 272 (but not *Alpheus ruber*, M.-Edw.).
1835. *Hippolyte megacheles*, Hailstone, *ibid.* p. 395.
1835. *Dienecia rubra*, Westwood, *ibid.* p. 552.
1837. *Alpheus Edwardsii*, Milne-Edwards, Hist. Nat. des Crust. vol. ii. p. 352 (but not of Audouin).
1846. *Cryptophthalmus ruber*, Costa, Fauna del Regno di Napoli, Crost. pl. 7. fig. 1.
1850. *Dienecia rubra*, White, Cat. Brit. Crust. in Brit. Mus. p. 41.
1854. *Alpheus affinis*, Guise, Ann. Nat. Hist. ser. 2. vol. xiv. p. 275.
1857. *Alpheus affinis*, White, Pop. Hist. Brit. Crust. p. 112.
1862. *Alpheus platyrhynchus*, Heller*, Sitzungsb. der Kais. Wiener Akad. d. W. Math.-naturw. Cl. xl. Bd. i. p. 400, pl. 1. figs. 21–24.
1863. *Alpheus platyrhynchus*, Heller, Die Crust. des südlichen Europa, p. 276, pl. 9. figs. 18, 19.
1868. *Alpheus Edwardsii*, Bate, Brit. Assoc. Rep. (1867), p. 283; Ann. Nat. Hist. ser. 4. vol. ii. p. 119.

Supraorbital portions of carapace produced into spine-like points; and these, together with the rostrum, give a tridentate anterior margin to the carapace. The right and left first pereiopods formed on nearly the same model, though differing in minute details, one (generally the left) larger than the other, and having the centre of its broad outer side produced forwards between the finger and thumb into a spine, above and below which the hand is excavated, the upper groove the larger, not curved; finger very flat, acute above, twisted, no tubercle on the inner margin. Smaller hand having that part of the thumb against which the finger impinges grooved; upper margins of both finger and thumb fringed with long setæ; inner margin of finger microscopically pectinated. Fingers of both hands articulating by a curious lateral movement.

Hab. Herm (Guise & A. M. N.), Jersey (A. M. N.), Hastings (Hailstone), off Dodman (Bate), Mediterranean (Milne-Edwards), Adriatic (Heller).

Alpheus ruber, Milne-Edwards.

?1814. *Cryptophthalmus ruber*, Rafinesque, Précis des découvertes somiologiques, &c.
?1825. *Cryptophthalmus ruber*, Desmarest, Consid. gén. sur Crust. p. 215.
1837. *Alpheus ruber*, M.-Edwards, Hist. Nat. des Crust. vol. ii. p. 351, and Atlas du Règne Animal de Cuvier, édit. trois., Crust. pl. 53. fig. 1.
1840. *Alpheus ruber*, Lucas, Hist. Nat. des Crust. p. 182.

* Beiträge zur näheren Kenntniss der Macrouren.

1849. *Alpheus ruber*, Bell, Brit. Stalk-eyed Crust. p. 271.
1850. *Alpheus ruber*, White, Cat. Brit. Crust. in Brit. Mus. p. 38; and (1857) Pop. Hist. Brit. Crust. p. 112, pl. 8. fig. 3.
1863. *Alpheus ruber*, Heller, Crust. des südlichen Europa, 274.

This species may at once be distinguished from the preceding by the four longitudinal carinæ of the larger and greatly flattened hand.

Three Cornish specimens of this species in my collection have the right hand the greatly developed organ; while a Mediterranean example and also that figured by Bell have the left the larger.

The description of *Cryptophthalmus ruber* of Rafinesque and Desmarest appears to be partly applicable to the last species and partly to this. The words, however, "la plus grande" (main) "est à trois angles en dessous" cannot possibly be reconciled with *A. megacheles*, though they may be with *A. ruber*, if what Milne-Edwards speaks of as the outer side be viewed as the under. The *Cryptophthalmus ruber* of Costa is unquestionably a synonym of the last species, and not of this.

Hab. Falmouth (Cocks), Polperro (Laughrin), Mediterranean (Milne-Edwards & Costa), Adriatic (Grube), Algerian coast (Lucas).

Typton spongicola, Costa.

1846. *Typton spongicola*, Costa, Fauna del Regno di Napoli, Crost. pl. 6 bis. figs. 1–6.
1856. *Pontonella glabra*, Heller*, Verhandlungen des zool.-botan. Vereins in Wien p. 629, pl. 9. figs. 1–15.
1861. *Alpheus Edwardsii*, Couch, Proc. Linn. Soc., Zoology, vol. v. p. 210 (but not *Alpheus Edwardsii* of Audouin, nor that of Milne-Edwards).
1863. *Typton spongicola*, Heller, Crustaceen des südlichen Europa, p. 254, pl. 8. figs. 12–17.
1868. *Typton spongiosus*, Bate, Brit. Assoc. Rep. (1867) p. 283, pl. 3. fig. 1; and Ann. Nat. Hist. ser. 4. vol. ii. p. 119.

The genus *Typton* differs from *Alpheus* in having the eyes free, and not concealed beneath the anterior portion of the carapace, in the second instead of the first pair of pereiopods being the more largely developed members, and in the mandible being without an appendage, whereas in *Alpheus* it is furnished with a two-jointed palp.

Seven or eight years ago, Mr. Laughrin, the intelligent coastguardsman of Polperro, found within the oscula of *Isodictya palmata*, procured off that coast, some shrimps. Mr. Couch gave an account of these in the Proc. Linn. Soc., naming them *Alpheus Edwardsii*, M.-Edw. One of these specimens came into my hands; and having compared it with a specimen of *Typton spongicola* from the Adriatic, I found

* Beitrag zur Fauna der Adria.

them to agree in every particular. Mr. Spence Bate considers a species he has now met with to be distinct from that of Costa, and names it *Typton spongiosus*; but no character is given which will distinguish it from the Adriatic and Mediterranean form. The proportionate length of the eye and rostrum differs in different specimens, possibly according to age. In his *generic* characters, Mr. Bate says that the right hand of the second pereiopoda is generally much larger than the left; but the contrary would seem to be the case from the descriptions and figures of both Costa and Heller, and from the Adriatic and British examples in my own collection. In the genus *Alpheus*, however, we have seen that the rule is not constant, and that in the same species sometimes the one and sometimes the other limb will be the larger in size, and have the peculiar points of structure of that organ as distinguished from the smaller. It must, in addition to this, be borne in mind that in this and allied species the animals upon the slightest provocation are willing to part with their large claws, and that consequently reproduced members of smaller size are not uncommon, and may easily be mistaken for fully developed limbs.

Hab. Polperro, Cornwall (Laughrin), Mediterranean (Costa), Adriatic (Grube & Heller).

Genus Axius.

I have not examined the typical specimen of *Axius stirynchus*; but all the examples of *Axius* I have seen agree closely with the description, referred to by Mr. Bate, of the late Mr. R. Q. Couch (Zoologist, 1856, p. 5282) of a form which he considered distinct from Leach's species. My collection contains five specimens procured by Mr. Dodd in Jersey, and one taken by the Rev. R. N. Dennis, at Seaford, Sussex. All these have the telson quadrangular, the hands smooth, the fingers channelled, the particular articulation of cephalothorax and abdomen described by Mr. Couch, and the transverse lateral tufts of hair on the abdominal segments. All the points of difference indicated are probably at the most sexual. My specimens are in spirits: it is not improbable that, in drying, the sides of the telson would curl downwards; and thus that portion of the body might easily assume the "elongate-triangular" form ascribed to it by Leach and Bell. At least we require further knowledge before it would be wise to give a distinctive name to the form in the collections of the late Mr. R. Q. Couch and myself. The young in this genus are much more hirsute than full-grown individuals.

Crangon sculptus and *fasciatus*.

I am surprised at Mr. Bate's suggestion that *Crangon sculptus* and *Crangon fasciatus* are the same species. In my humble judgment, no two Crangons belonging to the same section of the genus can have stronger distinctive features. Can it be that Mr. Bate has not met with the true *C. fasciatus*? The differences are not confined to the number of spines: there are other characters; and of far more consequence is the fact that, whereas in *C. sculptus* the abdomen is elaborately ornamented with beautiful sculpturing, in *C. fasciatus* it is quite smooth. Dr. Kinahan's figures and description of this latter species are very good (Trans. Royal Irish Acad. vol. xxiv. (1861) p. 76; and Proc. Royal Irish Acad. 1862, p. 362, pl. 12). *Crangon nanus*, Kröyer (= *C. bispinosus* of Hailstone) appears to me to be the species most closely related to *C. fasciatus**.

P.S. As though to confirm what I have just said—among some shrimps dredged during the past month in Shetland by Mr. Jeffreys, and received from him this morning, I find several *C. fasciatus*, but there are no *C. sculptus*; nor is that species known to inhabit the Shetland seas. I have never found these two species in company, nor seen a specimen intermediate in character. *Crangon fasciatus* I have dredged off the Northumberland coast (where *C. sculptus* has not been found at all), at Falmouth, and off Guernsey; and *C. sculptus* I have procured in the Minch, Lamlash Bay, and Guernsey.

XVI.—*Contributions to the Study of the Entomostraca.*

By George Stewardson Brady, C.M.Z.S. &c.

No. II. *Marine Ostracoda from the Mauritius.*

[Plates XII. & XIII.]

The species here described have been found in mud brought from the Mauritius, and kindly placed in my hands by my friends Messrs. Thomas Blain and E. C. Davison, of Sunderland. It is interesting to note that two of the species, *Cythere Darwinii* and *C. Hodgii*, occur also in the Malay archipelago, and that the specimens from the Mauritius exhibit slight, but decided differences; while *Macrocypris maculata*, *Xestoleberis margaritea*, and *Cytheridea punctillata* have a still wider range

* Judging from Kröyer's figures of *C. boreas*, Phipps, in the 'Naturhistorisk Tidskrift,' vol. iv. (1842) p. 218, pl. iv. figs. 1–14, I should conclude that it is distinct from all our British species.

of distribution, extending even into the European seas. Some additional species from the same locality will be described in a future Number of 'Les Fonds de la Mer.'

List of Species.

Pontocypris attenuata, *nov. sp.*
—— Davisoni, *nov. sp.*
Macrocypris maculata, *Brady.*
Cythere demissa, *nov. sp.*
—— plana, *nov. sp.*
—— fumata, *nov. sp.*
—— Hodgii, *Brady.*
—— Darwinii, *Brady**.
Cythere hamigera, *nov. sp.*
—— bispinosa, *nov. sp.*
—— convoluta, *nov. sp.*
Cytheridea punctillata, *Brady.*
—— spinulosa, *nov. sp.*
Loxoconcha Lilljeborgii, *nov. sp.*
Xestoleberis margaritea, *Brady.*

Pontocypris attenuata, nov. sp. (Plate IV. figs. 11–14.)

Carapace, as seen from the side, subtriangular or siliquose, highest in front of the middle, and tapering to a point behind; greatest height scarcely equalling half the length: anterior extremity broadly rounded; posterior subacutely pointed: superior margin obtusely angular at its highest point, from which it slopes steeply backwards with a gentle curve; inferior slightly sinuated about the middle: outline, as seen from above, compressed, somewhat clavate, widest at the anterior third, rounded and slightly mucronate in front, pointed behind; greatest width equal to rather more than a third of the length. End view oval, widest in the middle. Surface of the shell smooth, slightly punctate, and clothed with numerous exceedingly short and fine hairs. Colour pale yellowish brown. Length $\frac{1}{3\,8}$ inch. Animal unknown.

This pretty species approaches very closely to the European *P. mytiloides*, but is paler in colour, less distinctly pubescent, has a more shining surface, a more angular dorsal margin, and is also destitute of serratures at the posterior extremity.

Pontocypris Davisoni, nov. sp. (Plate XIII. figs. 9, 10.)

Carapace of the *female* (?) somewhat tumid, as seen from the side subreniform, highest in the middle; greatest height fully equal to half the length; rounded in front: posterior extremity rounded off below, scarcely angular; superior margin boldly arched, highest in the middle, inferior sinuated in front of the middle. Seen from above, the outline is ovate, widest near the middle, pointed in front, rounded behind; width much less than the height. The surface of the shell is granular or very finely punctate, and quite devoid

* Described in 'Les Fonds de la Mer.'

of hairs: colour whitish, semitransparent, with an opaque milk-white central patch and marginal belt. Length $\frac{1}{32}$ inch.

I have much pleasure in inscribing this species to my friend Mr. E. C. Davison, whose untiring diligence in collecting and general interest in all subjects connected with marine zoology have materially helped my own studies in this department.

Cythere demissa, nov. sp. (Plate XII. figs. 1, 2.)

Somewhat similar to *C. pellucida*, but much smaller. Seen from the side, oblong, rather higher in front than behind; greatest height equal to about half the length: anterior extremity broadly rounded, posterior subtruncate, and armed below the middle with four small teeth: superior margin straight, or very slightly curved; inferior deeply sinuated in front of the middle. Viewed from above, the shell is oblong-ovate, slightly constricted in the middle, broader behind than in front; extremities obtuse; width less than the height. Surface covered with closely set rather coarse punctations. Length $\frac{1}{60}$ inch.

Cythere plana, nov. sp. (Pl. XIII. figs. 7, 8.)

Valves, seen from the side, elongated, subquadrangular, nearly equal in height throughout; height considerably less than half the length: anterior extremity evenly rounded; posterior rounded above, obsoletely angular below: superior margin straight; inferior also nearly straight, but distinctly sinuated in front. Outline, as seen from above, compressed ovate. Surface of the shell smooth and polished, bearing numerous small, distant, rounded papillæ, and round the margins several long radiating hair-like lines. Colour dull brown. Length $\frac{1}{33}$ inch.

Three or four separated valves only of this species were obtained.

Cythere fumata, nov. sp. (Plate XII. figs. 13, 14.)

Carapace compressed. Seen from the side, angular, subreniform, highest in front of the middle; greatest height equal to more than half the length: anterior extremity broadly and obliquely rounded, posterior subtruncate, slightly produced below: superior margin sloping steeply and in a slightly waved line from before backwards, and terminating in a somewhat produced obtuse angle; inferior margin deeply sinuated in the middle. Seen from above, compressed, subhexagonal, widest in the middle, and tapering evenly to the extremities, which are obtusely pointed; width equal to less

than half the length. Surface of the valves covered with closely set angular excavations, arranged in a subradiate manner, and bearing just within and parallel to the anterior margin a prominent raised ridge. Colour smoky brown. Length $\frac{1}{38}$ inch.

Cythere Darwinii, Brady. (Plate XII. figs. 11, 12.)

Cythere Darwinii, Brady, Les Fonds de la Mer.

The specimens found in the Mauritius mud differ somewhat in shape and surface-markings from the type specimens, which were collected in the sea of Java. I have therefore thought it desirable to give a figure. It will be seen that the outline here is less flexuous; but the essential characters of the species appear to be the same.

Cythere hamigera, nov. sp. (Plate XII. figs. 5–7.)

Carapace tumid, densely spinous. Seen from the side, subquadrangular, highest over the anterior hinge-joint; greatest height equal to more than half the length: anterior extremity broad and well rounded; posterior narrow, scarcely rounded: superior margin straight, rather steeply sloping, with a slight sinuation in front of the middle; inferior nearly straight. Seen from above, the outline is ovate, widest behind the middle, broadly rounded behind, obtusely pointed or subtruncate in front; greatest width scarcely equal to the height. Surface densely clothed with short tubercular spines, which towards the dorsal margin are often developed into sharp, reflexed, hook-like processes. Length $\frac{1}{45}$ inch.

Cythere bispinosa, nov. sp. (Plate XII. figs. 8–10.)

Shell tumid. Seen from the side, subtrapezoid; greatest height in front of the middle, and equal to more than half the length: anterior extremity obliquely rounded, bordered with a thin squamous lamina; posterior emarginate above, produced below the middle into a prominent subdentate beak: superior margin sinuated in the middle, suddenly sloping at each extremity; inferior slightly convex in the middle, and sinuated toward the extremities. Seen from above, ovate, widest behind the middle; extremities broadly rounded, mucronate. End view almost rectangular, with irregularly jagged margins. Surface of the valves uneven, beset with numerous small tubercles, and bearing three sharply cut longitudinal crests, that within the ventral margin terminating behind the middle in a sharp projecting spine. Length $\frac{1}{35}$ inch.

Cythere convoluta, nov. sp. (Plate XII. figs. 3, 4.)

Carapace of the *female* (?), seen from the side, subquadrangular, highest in front of the middle; greatest height equal to about two-thirds of the length: anterior extremity broadly rounded; posterior produced below the middle into a broad slightly dentate process, emarginate above: superior margin slightly arched in front, excavated behind the middle; inferior almost straight, bending upwards behind. Seen from above, the outline is irregularly ovate or subhexagonal, constricted in the middle, broadly mucronate before and behind; greatest width near the middle, equal to more than half the length. Surface of the valves sculptured with prominent, flexuous, reticulating ridges, and with a prominent sharp crest running entirely round and a little within the margins, but less conspicuous posteriorly. Length $_4^1{}_2$ inch.

Cytheridea punctillata, Brady.

Cytheridea punctillata, Brady, Ann. & Mag. Nat. Hist. 1865, vol. xvi. p. 189, pl. 9. figs. 9–11.

Carapace of the *female* (?), seen from the side, subreniform, highest in front of the middle; greatest height equal to half the length: anterior extremity well and evenly, posterior obtusely rounded: superior margin gently arched, inferior nearly straight. Seen from above, ovate, pointed in front, broadly rounded behind, scarcely constricted in the middle; greatest width near the posterior extremity, equal to about half the length. Surface marked with closely set rounded puncta, and a few minute round papillæ.

I cannot distinguish the examples here described from the European species *Cytheridea punctillata*, which occurs abundantly in some parts of the British and Scandinavian seas, and also, as a fossil, in the posttertiary clays. There are, indeed, some slight differences of form and sculpturing; but these seem subject to much variation, and are certainly not of sufficient importance to warrant our regarding them as indices of specific rank.

Cytheridea spinulosa, nov. sp. (Plate XIII. figs. 1–6.)

Structure of the shell very robust and thick; valves tumid. As seen from the side, almost elliptical, highest near the middle; greatest height equal to more than half the length; extremities broadly and obtusely rounded, and bearing below the middle a series of (about twelve on the anterior and six on the posterior) short rounded marginal teeth: superior margin feebly arched, highest in the middle; inferior almost

straight. Outline, as seen from above, subcuneiform, widest behind the middle, obtusely mucronate in front, broadly rounded and centrally emarginate behind; greatest width equal to half the length. End view broadly ovate. Shell covered with large, distant, subcircular or obscurely angular pittings, and raised behind the middle into a rounded eminence. Colour white. Length $\frac{1}{4\frac{1}{2}}$ inch.

Loxoconcha Lilljeborgii, nov. sp. (Plate XIII. figs. 11–15.)

Carapace of the *female*, as seen from the side, subrhomboidal, highest in the middle; greatest height equal to nearly two-thirds of the length: anterior extremity obliquely rounded; posterior produced above the middle into a short (often bidentate) process: superior margin arched, highest near the middle, behind which it is gently sinuated; inferior sinuated in front, protuberant behind. Outline, as seen from above, subovate or obscurely pentagonal, widest about the middle, pointed in front, strongly mucronate behind; greatest width much less than the height. Shell marked throughout with large oblong pittings, which are arranged in concentric rows, and tend to form furrows by their coalescence on the ventral surface: a conspicuous angular protuberance near the postero-dorsal angle of each valve. Length $\frac{1}{4\frac{1}{3}}$ inch.

L. Lilljeborgii is in general appearance not very unlike a West-Indian species (*L. avellana*) described by me in Trans. Zool. Soc. vol. v.; but the present species is well characterized by the posterior dorsal protuberance, and is, moreover, of very different outline when seen from above or below. *L. affinis*, a Mediterranean species, is also a nearly allied form.

EXPLANATION OF THE PLATES.

Plate XII.

Fig. 1. *Cythere demissa*, seen from left side.
Fig. 2. The same, from above.
Fig. 3. *Cythere convoluta*, seen from left side. } ×40.
Fig. 4. The same, from above.
Fig. 5. *Cythere hamigera*, seen from right side.
Fig. 6. The same, from above. } ×50.
Fig. 7. The same, from front.
Fig. 8. *Cythere bispinosa*, seen from left side.
Fig. 9. The same, seen from below.
Fig. 10. The same, from front.
Fig. 11. *Cythere Darwinii*, from left side. } ×40.
Fig. 12. The same, from below.
Fig. 13. *Cythere fumata*, from left side.
Fig. 14. The same, from below.

PLATE XIII.

Fig. 1. *Cytheridea spinulosa*, from left side.
Fig. 2. The same, from above.
Fig. 3. The same, from below.
Fig. 4. The same, from front. } ×40.
Fig. 5. The same, hinge-margins.
Fig. 6. The same, ventral contact margins. } ×84.
Fig. 7. *Cythere plana*, left valve, from side.
Fig. 8. The same, from above.
Fig. 9. *Pontocypris Davisoni*, from left side.
Fig. 10. The same, from below.
Fig. 11. *Loxoconcha Lilljeborgii*, from left side. } ×40.
Fig. 12. The same, from above.
Fig. 13. The same, from below.
Fig. 14. The same, from front.
Fig. 15. The same, from behind.

XVII.—*On the existence of Capillary Arterial Vessels in Insects.* By JULES KÜNCKEL*.

ZOOLOGISTS supposed that the circulation of the blood in insects was limited to certain currents detected by Carus in transparent larvæ, when in 1847 M. Blanchard proved that the tracheæ of these animals fulfilled the function of arteries, by conveying, in a peripheral space, the nutritive fluids to all the organs. He ascertained, by means of delicate injections, the existence of a free space between the two membranes composing the tracheæ: the injected fluid expelled the blood and replaced it.

After having verified and confirmed M. Blanchard's discovery, M. Agassiz insisted upon the evidence of the demonstration. Seeking afterwards to complete this discovery, he paid particular attention to the termination of the tracheæ. In a memoir published in 1849†, this naturalist distinguished the ordinary tracheæ terminating in little ampullæ and the tracheæ terminated by little tubes destitute of a spiral filament, which he named the *capillaries of the tracheæ*. M. Agassiz expresses himself as follows:—"In the grasshoppers which I injected by the dorsal vessel I found in the legs the muscles elegantly covered with dendritic tufts of these vessels (the capillaries of the tracheæ) all injected with coloured matter; and in a portion of a muscle of the leg of an *Acridium flavovittatum*, submitted to a high magnifying-power, I observed the distribution of these little vessels, which has a striking resemblance to the

* Translated from the 'Comptes Rendus,' July 27, 1868, tome lxvii. pp. 242–244.

† Proc. American Association, 1849, pp. 140–143; translated in Ann. des Sci. Nat. 3e sér. xv. pp. 358–362.

distribution of the blood-vessels in the bodies of the higher animals."

Nearly twenty years have passed since the period when M. Agassiz announced these facts, which appear to have been but little understood; for the authors who have written on the anatomy and physiology of insects have not even mentioned them.

The direct observation of the phenomenon of circulation was wanting: no one had succeeded in detecting the movement of the blood either in the peritracheal space or in the capillaries; and M. Milne-Edwards indicated as a fact to be regretted that "the existence of currents in the tubiform lacunæ had not yet been ascertained." Having been led, by general researches upon the organization of the Diptera, to study the apparatus of circulation and respiration, I have frequently examined the tracheæ. I always saw, without difficulty, the globules between the two coats; but, the animals being dead, the blood was motionless. In pursuing my investigations of the distribution of the tracheæ in the muscles, I was too much struck by the character of this distribution not to dwell upon it. Having succeeded in removing a muscular bundle from a living *Eristalis*, without tearing it, and brought it quickly into the focus of a powerful microscope, I had the surprise of seeing the blood imprisoned between the two membranes of the tracheæ running in this peritracheal space, and penetrating into the finest arterioles. I observed the course of the blood-globules with the same facility as in the capillaries of the mesentery or the membrane uniting the digits of a frog. I was, therefore, fortunate enough to see the circulation of the blood in the capillaries of insects.

I have been able to convince myself of the existence of a system of arterial capillaries in all insects: the most delicate arterioles creep not only through the muscles, but also over the other organs. In general the blood thus observed by transmitted light presents a rosy tint very favourable for observation. When the blood abandons the tracheæ and its arterioles, which I have frequently seen, they lose their coloration. The trachea, recognizable by its spiral filament, may always be perceived; but it is very difficult to distinguish the arterioles, so delicate and transparent are their walls.

The difficulties of the experiment are great. The insect must be quickly opened, a muscular bundle must be taken from the living animal, and this bundle conveyed under the microscope; and then, under favourable conditions, the blood is seen flowing rapidly through the arterioles. For these investigations a considerable magnifying-power is necessary. I

have been singularly aided by the very perfect immersion-objectives which M. Nachet was kind enough to place at my disposal.

It is necessary to give a precise explanation of the structure of the arterioles and their mode of distribution.

The tracheæ, as is well known, are composed of two coats: the inner coat forms the envelope of the aëriferous canal; the outer coat, or peritracheal membrane (*peritoneal membrane* of the Germans), surrounds the former envelope, leaving an interval, the peritracheal space. But at the point where the tracheæ penetrate between the muscular fibres, the inner coat disappears, and the aëriferous canal terminates cæcally, whilst the outer coat or peritracheal membrane becomes the wall of the blood-vessels or arterial capillaries. It is not only the spiroid thickening of the inner coat, or spiral filament, that disappears, it is the inner coat itself that stops and suddenly closes the aëriferous canal. In this way we see, starting from a more or less voluminous tracheal stem, very delicate blood-vessels, in larger or smaller number, which divide and subdivide regularly to their extremities.

The blood retained in the peritracheal space remains throughout its course in contact with oxygen; it reaches the capillaries perfectly vivified, and is a true arterial blood. The capillaries are not in communication with venous capillaries; the blood diffuses itself through the tissues, nourishes them, and falls into the lacunæ; the lacunar currents convey it again to the dorsal vessel.

Thus, to sum up, the tracheæ of insects, which are aëriferous tubes in their central portion and blood-vessels in their peripheral part, become at their extremities true arterial capillaries.

XVIII.—*On* Aranea lobata, *Pallas* (A. sericea, *Oliv.*).

By T. Thorell*.

This large and well-marked Epeirid, which Pallas described and figured in 1772 (in 'Spicilegia Zoologica,' t. i. fasc. 8. p. 46, tab. 3. figs. 14, 15) under the name of *Aranea lobata*, and of which arachnologists have hitherto possessed only doubtful or incorrect notions, is, as the following remarks will render evident, identical with the form known under the appellation *Argiope* l. *Epeïra sericea* (Oliv.), which, by its size and beauty, its unusual aspect, and its general occurrence, attracts notice more than any other species of spider, except

* Translated from the 'Öfversigt af Kongl. Vetenskaps Akademiens Förhandlingar,' 1867, No. 9, by Arthur W. E. O'Shaughnessy.

perhaps the splendid *Argiope Brünnichii**, in the arachnoid fauna of the south of Europe, now even attaining the unknown northern limit of that fauna.

When Pallas published the first or Latin edition of his above-named work, he was ignorant of the habitat of *A. lobata*, and unfortunately advanced a supposition that the species was probably the same as Petiver's *Araneoides Cap. fasciata lutescens*, &c.†. It is, beyond a doubt, this circumstance only which has caused later writers to overlook the correspondence of Olivier's *A. sericea* and Pallas's *A. lobata*; for, although the description and figures which Pallas has left are not particularly well marked, they are sufficiently accurate to enable any one looking at them with unprejudiced eyes to recognize in *A. lobata* its identity with *A. sericea*.

We have only to recollect that the examples which Pallas had before him were preserved in spirit: in such examples the silky down which covers the body is not apparent, whereas one easily perceives the two dark longitudinal bands and the large black transverse spots in front of the petiolus conspicuous in Pallas's representation, as also the "lineæ bis geminæ fuscescentes supra apicem abdominis subtrilobum longitudinales" of which he speaks, which marks are, on the contrary, in living or dried examples, more or less hidden by the silk-like covering of hair.

Pallas states (*loc. cit.*) that he met with several specimens of his *A. lobata* "in Museo Academiæ Petropolitanæ:" probably they came from Southern Russia, where this spider had been already found in 1768 by Lepechin. His "Aranea senoculata thorace depresso, abdomine exovato globoso lobato, punctis in dorso 4 nigris"‡ (which received from Gmelin, in Linn. Syst. Nat. ed. 13, the name *A. argentea*), is in fact indisputably nothing else than a variety of the common *A. sericea*, which also was later observed in South Russia (Crimea) by Al. v. Nordmann§.

But, should there yet remain, in spite of the agreement of the two descriptions, any doubt as to the European origin of

* *Aranea Brünnichii*, Scop. (Annus V. Hist.-Nat.: 1772) = *Aranea fasciata*, Oliv. (1789) l. *Epeïra* (*Nephila*) *fasciata* Auct. rec.

† Petiver, 'Gazophylacium Naturæ et Artis,' i. tab. 12. f. 11; Catalogus classicus et topicus, p. 3, No. 440.

‡ Lepechin, 'Tagebuch der Reise durch verschiedene Provinzen des Russischen Reiches in den Jahren 1768 u. 1769.' Uebers. von C. W. Haase. Th. i. p. 316, Taf. 16. fig. 2 (1774). (The first part of the Russian original was printed in 1771).

§ "In the Crimea I have sat for a whole hour opposite the web of the beautiful *Argyopes sericeus*, the large female in the centre, the small male at the edge of the wide-meshed web."—Nordmann, "Erstes Verzeichniss der in Finnland und Lappland gefundenen Spinnen, Araneæ," in Bidrag till Finlands Naturkännedom, Etnografi och Statistik, viii. p. 18 (1863).

A. lobata, and its identity with *A. sericea* which is dependent upon that fact, it will be sufficient and conclusive to consult the German edition of the Spicil. Zool. fasc. 9, translated and revised by Pallas himself, and printed in 1777 under the title 'Naturgeschichte merkwürdiger Thiere,' 9te Sammlung, pp. 71, 72. From the account therein given of *A. lobata* we extract the following:—

"....the true country of the spider the description of which I have already furnished from preserved specimens. I have met with it in the warm southern parts about the Wolga, and on the Upper Irtisch, and have indeed found it already perfectly developed in the month of May. It has also been noticed by my lamented friend Prof. Falk in the corners of houses in Zariczan; and Prof. Lepechin, who has described and figured it in the first part of his Russian Voyage (p. 395, pl. 16. fig. 2), found it under the hollow bark of a tree, brooding over its eggs" (*loc. cit.* p. 72).

Thus we find,—first, that Pallas expressly gives the south of Russia (both in Europe and Asia) as the country of *A. lobata*; and, secondly, that, according to Pallas, Lepechin's above-named *Aranea* ("abdomine lobato," &c.) is the same species as the *A. lobata*, Pallas.

Both Pallas and Nordmann in the above-cited passage give us every reason to suppose that this species is as far from being one of the rarer forms of spider in the south of Russia as it is indeed in Italy and the south of France.

Attention having been once called to the matter, no one would henceforth think of believing Pallas's *A. lobata* to be the same as Petiver's "*Araneoides capensis*" from the Cape of Good Hope; also Olivier's specific name *sericea* must give place to the much older one of *lobata*, and the species be henceforth known as *Argiope lobata* (Pallas).

Fabricius adopts *A. lobata* in the 'Species Insectorum' (1781), after Pallas (Spicil. Zool.); and while he cites this author, he includes also, but with a query, Petiver's species from the Cape among the synonyms, doubtless on the ground of Pallas's previously hazarded guess concerning the habitat of *A. lobata*. He does the same in the 'Mantissa Insectorum' (1787). For the *habitat* of the species, Fabricius, in both these works, has candidly left a blank. But some years later (1793), in the 'Entomologia Systematica' (tom. ii. p. 407), while giving the same diagnosis and synonymy for *A. lobata* as in the 'Species Insectorum,' he says, "Habitat ad Caput Bonæ Spei," showing that he now abandoned his former uncertainty as to the country of this species, and, of his own accord, regarded it as exclusively exotic—an assumption

which has been admitted ever since*. We see, however, from this that Fabricius had no knowledge of Pallas's *A. lobata* beyond that which he derived from the Spicil. Zool., and moreover that he was as unacquainted with the above-cited passage in Pallas's 'Naturgesch. merkw. Thiere' as any one of the various authors who have occupied themselves with Olivier's *A. sericea*.

Walckenaer (Hist. Nat. d. Ins. Apt. p. 117) believes, curiously enough, that the true *Ep. sericea* does not belong to the European fauna. This is the more unaccountable, from the fact that Olivier, who first described this spider under the specific name *sericea*, expressly says that he found it "frequently in Provence." Walckenaer nevertheless accepts as properly a European species the *E. dentata* (Risso), differing from *A. sericea* merely in markings, which, coming from Nice, is consequently from almost the very same region (south of France) where Olivier found his *Aranea sericea*! Walckenaer seems to be as little acquainted from personal observation with *E. dentata* (his description of it is a mere extract from Risso) as with any European example of *A. sericea*.

The specimens of the species in question, however, which I have seen, and which I collected in Italy in the tracts about Naples, where Costa also found "*Epeïra sericea*"†, agree perfectly not only with Pallas's *A. lobata*, but also with the descriptions and figures which Olivier, Latreille, Walckenaer, and Audouin have left us of *A.* (*E.*) *sericea*. They lack the markings which belong to "*E. dentata*" according to Risso's (and Walckenaer's) representation of that form, which, however, is certainly only a colour variety of "*E. sericea*" l. *lobata*.

To "*E. dentata*" Walckenaer rightly refers Lepechin's above-named "*Aranea* (... abdomine ... lobato, &c.)" (*A. argentea*, Gmel.), which, as we have already seen, is allowed by Pallas himself to be identical with his *A. lobata*; here also should undoubtedly be referred *Argyopes prælautus*, Koch, from Turkey (tracts of the Balkan), as Walckenaer has supposed.

* Walckenaer says (Hist. Nat. d. Ins. Apt. ii. p. 116), with reference to *Epeïra argentata* (Fabr.), "Conférez pour cette espèce Pallas, 'Spicilegia Zoologica,' fasc. 9. p. 46, tab. 3. figg. 13 et 14" (it should be "14 & 15")—that is to say, the descriptions and figures of *A. lobata*, which, however, do not in the least agree with Walckenaer's description of *E. argentata*, but do agree very well with that which he gives of *E. sericea*. *E. argentata*, moreover, comes from America ("India," Fabr.).

† O. G. Costa, 'Cenni zoologici ossia descrizione sommaria delle specie nuove di animali discoperti in diverse contrade del regno nell' anno 1834,' p. 16 (1834).

The most important synonyms of this remarkable species, which is spread over the whole of Southern Europe, from Spain in the West to Southern Russia in the East, Southern Siberia, Northern Africa (Egypt, Algeria*), and which has even been observed in the Cape Verde Islands and in Senegal, should be as follows:—

Argiope lobata (Pall.) 1772.

Var. *α*, sive *forma principalis*.

Syn. *Aranea lobata*, Pallas, Spicil. Zool. i. fasc. 9. p. 46, tab. 3. figg. 14 et 15 (1772).
—— ——, Pallas, Naturgesch. merkw. Thiere, i. 9te Samml. p. 71, pl. 3. figg. 14 et 15 (1777).
—— ——, Fabr. Spec. Insect. p. 536 (1781).
—— ——, Gmel. Linn. Syst. Nat. ed. 13. t. 1. pl. 5, p. 2955 (1789?).
—— *sericea*, Oliv. Encycl. Méth. iv. pp. 188 et 198 (1789).
Epeïra sericea, Latreille, Gen. Crust. et Ins. i. p. 107 (1806).
—— ——, Hahn, Die Arachn. i. p. 8, fig. 4 (1831).
—— —— Walck., Hist. Nat. d. Ins. Apt. ii. p. 116 (1841).
—— *margaritacea*, Risso, Hist. Nat. d. princip. Product. de l'Europe mérid. v. p. 40 (1826).
Argyope sericea, Sav. et Aud. in Descr. de l'Egypte, ed. 2. xxii. p. 334, pl. 2. fig. 6 (1827).

Var. *β*.

Aranea argentea, Gmel. Linn, Syst. Nat. ed. 13. t. i. pl. 5, p. 2959 (1789?).
Segestria dentata, Risso, Hist. Nat. d. princ. Prod. de l'Europe mér. v. p. 161 (1827).
Epeïra dentata, Walck. Hist. Nat. d. Ins. Apt. ii. p. 118 (1841).
Argyopes prælautus, Koch, Die Arachn. v. p. 37, fig. 359 (1839).

In conclusion, I would say a few words respecting the generic name *Argiope*, which is usually written *Argyope* or *Argyopes*. Both in the passage in the 'Description de l'Egypte,' where the genus is characterized by Audouin (t. xxii. p. 328, in ed. 2), and in the index to the same part (p. 466), the *Latin* name employed is *Argiope*; but in *French* it is *Argyope* ("Genre Argyope, *Argiope*," just as Audouin writes elsewhere "Genre Tégénaire, *Tegenaria*," "Genre Pholque, *Pholcus*," "Genre Faucheur, *Phalangium*," &c.). Later, in describing the species, he has used this latter form of the word, not only for the French, but also for the Latin name. However, as Audouin *first*, and *in characterizing the genus*, wrote *Argiope*, and as this is moreover the only correct orthography (the name is in fact formed from Ἀργιόπη, nom. prop. myth. femin. gen.), it should be retained through the

* Probably also over the eastern maritime countries of the Mediterranean. In Syria occurs an allied form, *Argiope splendida*, Sav. & Aud., which is possibly not specifically distinct from *A. lobata*.

rejection of the barbarous *Argyope*, which has obtained currency with Lucas, Walckenaer and others. Latreille* has changed it (on what grounds I know not) to *Argyopes*, making it a masculine; and he is followed by Sundevall, Koch, Keyserling, and others. It is desirable that the genus should henceforth resume its original and correct name—*Argiope*, Sav. & Aud.

XIX.—*Observations on some of the* Heliotropieæ.

By John Miers, F.R.S., F.L.S., &c.

[Concluded from p. 133.]

Messerschmidtia.

The late Mr. Robert Brown (in 1810) pointed out the necessity of constituting a distinct genus for those species of *Tournefortia* which differed from all the others in having the border of the corolla cleft into subulate lobes, a baccate fruit containing four nucules (each unilocular and monospermous), the seed with a very curved embryo and a superior radicle (Prodr. p. 496); but he omitted giving a name to the genus. In 1819 Römer and Schultes adopted this view, calling the genus *Messerschmidtia*, a name previously given by Linnæus to those species of *Tournefortia* which have a fruit with two nucules, each 2-celled. As such characters, according to their showing, belonged to *Tournefortia* proper, the *Messerschmidtia* of Linnæus naturally fell to the ground. Adopting it, therefore, for the group in question, they enumerated eleven species, all natives of the New World, mostly climbing or subscandent plants; but it is strange that among these there appears only one species that answers to the essential characters of their own generic diagnosis. G. Don (1837), following the same train, amplified the species to twenty-four, in total disregard of the distinguishing features of *Messerschmidtia*, associating with them several belonging to *Heliophytum*. Endlicher (1838) acknowledged the genus, and gave it a tolerably correct diagnosis, though with some few errors. By some authors the name has been applied to other very different groups, selected from *Tournefortia*; and this has caused no little confusion. DeCandolle, in his elaboration of the *Borragineæ* (in 1845), quite ignored *Messerschmidtia* as a genus, admitting neither that of Linnæus nor of Römer and Schultes; but he retained this name, as a section, for a small number of species of *Tournefortia* possessing very different characters (Prodr. ix. 528).

* Cuvier's Règne Animal, nouv. éd. iv. p. 70 (1829).

Fresenius (in 1857), in Mart. Flor. Bras., enumerated twenty-six Brazilian species of *Tournefortia*, among which are several belonging to *Messerschmidtia*; but he did not adopt this name, even as a section, apparently unaware of the peculiar structure of its fruit: the species of both these genera are therefore indiscriminately mingled together in that work. In order to clear away the mystification engendered by these several discordant views, it appears necessary to define the true limits of *Messerschmidtia* with greater accuracy—a task of no great difficulty, as I have found its characters constant in all the species I have examined. It may readily be distinguished from *Tournefortia* and *Heliophytum* by its four monospermous nucules, in which respect, however, it accords with *Heliotropium*; but it differs from all those genera in the greater length of its narrow acuminated sepals, in the narrow segments of the border of its corolla, which are cleft to the base, in the hippocrepiform duplicature of its carpels, in the depressed form of its 4-lobed fruit, in the extreme curvature of its embryo, and generally in its climbing habit. *Heliophytum* and *Heliotropium* differ in the very imbricated æstivation of the lobes of their corolla. In *Tournefortia*, where the lobes of the border are not cleft to the base, these are simply folded together in a plicato-valvate æstivation, while the intermediate plicatures in the sinus of the lobes make a fornix over the mouth of the tube. In *Messerschmidtia* the extremely narrow lobes of the border in the bud are quite involute by the rolling inwards of their margins, the æstivation being thus subvalvate, not by the margins, but by the juxtaposition of the rounded inflected surfaces of the lobes.

Messerschmidtia, R. & Sch. (non Linn.).—*Sepala* 5, longe linearia, sæpe setiformia, erecta, tubum corollæ sæpe æquantia, persistentia. *Corolla* tubulosa, tubo angusto, plicis 5 longitudinalibus sulcato, cum angulis nervigeris, supra medium paululo inflato, fauce constricta, limbo ad basin 5-partito, laciniis linearibus vel anguste lanceolatis, stellatim expansis, æstivatione involutiva. *Stamina* 5, inclusa, infra faucem fere sessilia; *filamenta* brevissima, longe supra medium tubi orta, tenuia; *antheræ* obconice oblongæ, tubo 6-plo breviores, imo sagittatæ, dorso ad sinum affixæ, apicibus mucronatis pilosulis circa stigma fornicatim cohærentes, 2-loculares, loculis collateralibus rima longitudinali lateraliter dehiscentibus, glabræ. *Discus* parvus, hypogynus, margine crenulato. *Ovarium* conico-oblongum, in stylum gradatim angustatum, disco insitum, 4-loculare, loculis 1-ovulatis; *ovulo* suspenso. *Stylus* longiusculus, filiformis,

stamina attingens, glaber, apice incrassatus et turbinatus; *stigma* obtuse conicum, 4-sulcatum, pilosum. *Fructus* baccatus, parce carnosus, globose 4-gaster, depressus, in medio umbilicatus et styli vestigio notatus; *pyrenæ* 4, demum separabiles, dorso convexæ, intus angulatæ, hippocrepice plicatæ, carunculatæ, et hinc primum cohærentes, osseæ, indehiscentes, 1-loculares, 1-spermæ: *semen* hippocrepice curvatum; *integumentum* tenue; *albumen* parcum, carnosum; *embryo* conformis, *cotyledonibus* ovato-oblongis, foliaceis, incumbenter arcuatis, *radicula* supera ad stylum spectante 6-plo longioribus.

Suffrutices *Americani*, *plerumque Brasilienses*, *sæpius subscandentes;* ramis *tenuibus*, *sæpe fistulosis;* folia *alterna*, *petiolata*, *oblonga*, *integra*, *glabra*, *aut adpresse pilosa:* inflorescentia *axillaris et terminalis*, *divaricatim vel dichotome ramosa*, *ramis ultimis spicatifloris*, *apice recurvatis;* flores *parvi*, 1-*laterales*, *crebri*, *sessiles aut brevissime pedunculati*, *ebracteati*.

* Paniculæ axillares et subterminales.

1. *Messerschmidtia subulata*, Gardn. Lond. Journ. Bot. i. 532;—Tournefortia Gardneri, *A. DC. Prodr.* ix. 526; *Fresen. in Mart. Fl. Bras.* xix. p. 54;—Tournefortia lanceolata, *Fres. l. c.* p. 55;—scandens, ramulis teneribus, fistulosis, pilosiusculis; foliis oblongo-lanceolatis, acuminatis, imo rotundatis, submembranaceis, utrinque rugulosis et sparse adpresso-villosulis; petiolo pilosulo, limbo 12-plo breviore: paniculis axillaribus et terminalibus, pubescentibus, brevibus, crebre alternatim ramosis et spicatifloris; sepalis lobisque corollæ longe subulatis; baccis 4-gastris.—In Brasilia: *v. v.* prov. Rio de Janeiro (Jurujuba, Botafogo, et Rio Cumprido); *v. s.* Tejuco (Gardner, 175).

A slender climbing plant, frequent in the neighbourhood of Rio de Janeiro: its long slender branches are $\frac{1}{2}$ line thick, with axils about 2 inches apart; leaves 2–$3\frac{1}{2}$ inches long, 9–14 lines broad, on a slender petiole 2–3 lines long; panicle $\frac{1}{2}$ inch long, branching from the base with three or four alternate curving branches $\frac{1}{2}$ line apart, each 6 lines long, with about twelve sessile flowers closely uniserial on the upperside; sepals 2 lines long, $\frac{1}{4}$ line broad at base, setiform, ciliate on margins; tube of corolla 2 lines long, pilose outside, a little swollen below the mouth; segments patent, very narrow, with inflected margins $3\frac{1}{4}$ lines long; stamens cohering in the mouth by their barbated summits; style long, slender, swollen above, with an annular ring terminated by a conical pilose apex;

fruit baccate, 4-lobed, depressed, with four nuts, as in the generic diagnosis.

2. *Messerschmidtia Martii*, nob. ;—Tournefortia Martii, *Fresen. in Mart. Fl. Bras.* xix. p. 55 ;—subscandens, ramis teretibus, subglabris, in junioribus sparse pilosulis ; foliis oblongis, imo rotundatis, gradatim angustatis, acutis, membranaceis, supra densius, subtus sparse strigoso-pilosis, pilis e tuberculis albis et adpressis ; petiolo tenuissimo, pilosulo, limbo 8-plo breviore : paniculis axillaribus, laxis, bis dichotomis aut subpentastachyis, ramis subcompressis, valde divaricatis, pubescentibus, ultimis spicatifloris ; floribus sessilibus, 1-serialibus, puberulis.—In Brasilia, prov. Bahia et Espirito Santo : *v. s. in herb. meo* (Rio Ilheos, Mart.).

A plant 10–20 feet high, with scandent or weak straggling branches scarcely a line in thickness, with axils 6–9 lines apart ; leaves 2–3½ inches long, 1–1⅝ inch broad, on a very slender petiole 2½–3 lines long ; peduncle 8 lines long, with two divaricating arms 5 lines long, each bearing two or three floriferous spikes 1½ inch long, with about ten or twelve somewhat distant flowers ; sepals 1½ line long ; tube of corolla 2 lines long, swollen below the mouth, segments narrow, 1 line long, with introflected margins ; anthers cohering by their barbated summits ; ovary glabrous, subglobular, distinctly 4-lobed ; style swollen at its apex by a crenulated annular ring ; stigma short, conical and papillose.

3. *Messerschmidtia Organensis*, nob. ;—scandens, ramis pendentibus, flexuosis, fistulosis, angulato-compressis, glaberrimis ; foliis oblongis, imo rotundatis, acute acuminatis, membranaceis, utrinque glaberrimis, marginibus subrevolutis ; petiolo glabro, canaliculato, limbo 8-plo breviore ; axillis plerisque floriferis : paniculis supra-axillaribus, foliis paulo longioribus, glaberrimis, longe et tenuiter pedunculatis, ebracteatis, alternatim ramosis, ramis laxis, tenuibus, spicatifloris ; floribus remotiusculis, breviter pedicellatis ; sepalis et lobis corollæ longe subulatis.—In Brasilia, prov. Rio de Janeiro : *v. v.* ad Imbuhy in montibus Organensibus.

I found this very distinct species in 1838, growing in virgin forests. The axils are 1¼–1¾ inch apart ; the leaves are 2½–3 inches long, 10–13 lines broad, on a petiole 4–5 lines long. The panicles are always supra-axillary, 2½–3 inches long, completely glabrous, on a slender naked peduncle 1–1½ inch long, bearing eight or ten alternate slender patent spicated branches 6–9 lines long. The terminal panicle is pyramidal, 6 inches long, and compound, consisting of a great many alternate

branches like the axillary panicles, but without leaves: the uniserial flowers are 1½–2 lines apart, each on a pedicel ½ line long; the sepals are 1 line long, glabrous, with ciliated margins; the tube of the corolla 2 lines long, its segments 1 line long; the anthers cohere by their papillose summits; the style is slender, enlarged at its summit, and terminated by an oval, obtuse, pilose stigma.

4. *Messerschmidtia Blanchetii*, nob.; Tournefortia Blanchetii, *A. DC. Prodr.* ix. 524; *Fresen. in Mart. Fl. Bras.* xix. 52; —scandens, ramis teretibus, adpresse sericeis; foliis ovatis, acutissime acuminatis, imo obtusis, membranaceis, utrinque pilosis, subtus pallidioribus, nervis parum distinctis, petiolo limbo 10-plo breviore: paniculis axillaribus et terminalibus, divaricato-dichotomis, subferrugineo-pubescentibus; floribus in ramis ultimis spicatim sessilibus, remotiusculis; sepalis lanceolatis, acuminatis, tubo corollæ sericeæ dimidio brevioribus; limbi lobis anguste linearibus.—In Bahia (Blanchet, 1914) (*non vidi*).

A species much resembling *M. Salzmanni*. Leaves 2½–3 inches long, 20–24 lines broad, on a petiole 4 lines long; flowers 3 lines long.

5. *Messerschmidtia salicifolia*, Gardn. Lond. Jour. Bot. i. 181; —Tournefortia salicifolia, *DC. Prodr.* ix. 531; *Fresen. in Mart. Fl. Bras.* xix. p. 55;—scandens, ramis fistulosis, angulato-compressis, subflexuosis, molliter patenter pilosis; foliis oblongo-lanceolatis, lanceolatisve, imo obtusis, a medio sensim acuminatis, supra molliter pilosulis, subtus ferrugineo-glaucis, tomentoso-villosulis, marginibus ciliatis; petiolo patenter ferrugineo-villoso, limbo 12-plo breviore: paniculis axillaribus et terminalibus, folio longioribus et suboppositis, bis dichotome geniculatim divisis, ramis alternatim ramosis et spicatifloris, villosis; floribus remotiusculis, sessilibus; sepalis lobisque corollæ acutissimis; drupis 4-gastris, pilosis.—In Brasilia ad Rio de Janeiro: *v. v. et s.* Morro de Flamengo (Gardner, n. 81).

A climbing plant, not uncommon in the neighbourhood of Rio de Janeiro, with branches 1–1½ line thick, geniculately flexuose at the axils, which are about 1 inch apart; the leaves are 2–4 inches long, 5–18 lines broad, on a petiole 2–3 lines long. The panicle, 2 inches long and broad, has a peduncle 6 lines long, its primary very divaricated branches 4 lines long, the secondary branchlets 3 lines long, each bearing two or three spikes 6–9 lines long, with about ten to fifteen sessile flowers ¾ line apart; sepals 1 line long, clothed with long

hairs upon raised tubercles; tube of corolla 1 line long, with segments of equal length; anthers cohering in the mouth by their acuminated papillose summits; style glabrous, with a turbinated fringed summit, crowned by a short, oblong, pilose stigma.

6. *Messerschmidtia Vauthieri*, nob.;—Tournefortia Vauthieri, *DC. Prodr.* ix. 526; *Fresen. in Mart. Fl. Bras.* xix. 55;—scandens?, glaberrima, ramis angulato-sulcatis; foliis ellipticis, acuminatis, imo obtusis, petiolatis: paniculis axillaribus, ferrugineo-subvelutinis, folio dimidio brevioribus; sepalis corollæque lobis subulatis, tubo subvelutino dimidio brevioribus.—In Brasilia, in montibus Organensibus (*non vidi*).

From the above brief character, this species differs from *M. Organensis* in its always axillary panicles, of only half their length, and which are ferruginously velutinous; its leaves, somewhat smaller, have a comparatively longer petiole; and the flowers are pubescent. It is said to be near *M. macroloba*, but I have seen neither of them. Its leaves are stated to be $2\frac{1}{2}$ inches long, 8–12 lines broad, on a petiole 3–5 lines long; the corolla is 2 lines long.

7. *Messerschmidtia floribunda*, G. Don, Dict. iv. 370;—Tournefortia floribunda, *H. B. K.* iii. 79; *Röm. & Sch. Syst.* iv. 541; *DC. Prodr.* ix. 527 (*non Fresen. in Mart. Fl. Bras.* xix. 51);—scandens, ramis teretibus, cano-tomentosis; foliis oblongis aut ovato-oblongis, acuminatis, imo rotundatis, supra tenuissime pubescentibus, subtus cano-tomentosis; petiolo teretiusculo, cano-tomentoso: paniculis axillaribus, dichotome multifidis, cano-tomentosis; spicis 20–24, filiformibus, diffusis; floribus unilateralibus, distantibus; sepalis corollæque lobis acuminato-subulatis; drupis glabris, 4-gastris.—In Cumana (*non vidi*).

Kunth does not state the length of the inflorescence or the size of the leaves; but their petioles are said to be 3 or 4 lines long. Fresenius has confounded with this species the *M. membranacea*, Gardn., which is a very different plant.

8. *Messerschmidtia macroloba*;—Tournefortia macroloba, *DC. Prodr.* ix. 527; *Fresen. in Mart. Fl. Bras.* xix. p. 55;—scandens?, glaberrima, ramis teretibus, superne obtuse angulatis; foliis elliptico-lanceolatis, longe acuminatis, imo subobtusis; petiolo limbo 12-plo breviore: paniculis axillaribus et terminalibus, puberulis, folio multo brevioribus; sepalis lineari-lanceolatis, corollæ tubo dimidio brevioribus,

corollæ lobis subulatis, patentibus, tubum æquantibus.—In Brasilia, Rio de Janeiro (Lotschy) (*non vidi*).

Leaves 4–5 inches long, 1½ inch broad, on a petiole 3–4 lines long. It is remarkable for the extreme length of the lobes of the border of the corolla.

9. *Messerschmidtia vicina*, nob.;—ramis teretibus, rugosis, lignosis; ramulis subcompressis, angulato-sulcatis, junioribus pallidis, glabris; foliis oblongis, imo obtusis, apice acuminatis, submembranaceis, supra sparse scabridulis, rigide adpresso pilosis, pilis brevibus e tuberculis majusculis albis enatis, subtus pallidioribus, rugoso-punctatis, glabris, costa tantum subpilosa; petiolo supra plano, scabridulo, limbo 12–18-plo breviore: racemis axillaribus, subglabris, geniculatim flexuosis; ramulis alternis, 3–4, gracilibus; floribus remotiusculis, parvis, sessilibus; baccis glabris, 4-gastris.—In Brasilia: *v. s. in herb. Mus. Brit.*, Penêdo, Rio S. Francisco (Gardn. 1362).

The leaves are 3–4½ inches long, 1⅛–1½ inch broad, on a petiole 3 lines long; peduncle of inflorescence bare, 9 lines long, geniculated at the axils of the alternate branches, which are 5–6 lines apart, and 2½ diminishing to 1 inch long; sepals very narrow, 1 line long.

10. *Messerschmidtia ramiflora*, nob.;—scandens, ramis laxe ramulosis, ramulis pendentibus, fistulosis, compressis, sulcatis, subglabris; foliis oblongis, vix lanceolatis, imo acutis aut subobtusis, apice acuminatis, nervis tenerrimis, utrinque immersis, glaberrimis, nisi in costa parce puberula, fusco-viridibus, opace rugulosis, concoloribus; petiolo tenui, superne tomentoso, limbo 8-plo breviore: paniculis axillaribus, multiramosis; folium excedentibus, brevissime pubescentibus; pedunculo petiolo 3-plo longiore; ramis plurimis, alternis, longiusculis, simplicibus aut 2-fidis, uniserialiter spicatis; floribus remotiusculis, breviter pedicellatis; sepalis corollæque lobis longe subulatis.—In Brasilia: *v. s. in herb. Mus. Brit.*, Rio Parahybuna, prov. Minas Geraës (Gardner, 5037).

The axils are ¾ inch apart; the leaves 2¾–3¼ inches long, 1–1¼ inch broad, on a petiole 5 lines long; each axil is floriferous. The panicle is 3½–4½ inches long, upon a bare peduncle 1–1½ inch long, with many alternate branches, 3 lines apart, 1–2½ inches long, often bearing a small leaflet at its base; flowers 1-serial, 1–2 lines apart, slightly pubescent; sepals 1¼ line long; tube of corolla 1¾–2 lines long, below glabrous, segments 1 line long; anthers cohering by their barbate sum-

mits; ovary, style, and stigma $1\frac{1}{4}$ line long, glabrous; style four times the length of the ovary, turbinate at its summit, with a fringed margin, supporting a pilose ovate stigma one-tenth of its length.

11. *Messerschmidtia valga*, nob.;—ramis teretibus, lignosis, lenticellatis, ramulis striatellis; foliis ovato-oblongis, imo obtusis aut in petiolum acutiuscule decurrentibus, apice subacuminatis, submembranaceis, utrinque pilis brevibus e tuberculis sparsim adpresse strigosis, supra nervis tenuibus nigris immersis, subtus paulo prominulis, livide glaucis; petiolo superne sulcato, pilosulo, limbo 5–6-plo breviore: paniculis axillaribus, folium æquantibus, parce pilosis, pedunculo petiolo æquilongo; rachi brevi, flexuosa, divaricatim bisdichotoma, aut tristachya; ramis rigidulis, spicatifloris; floribus 1-serialibus, remotiusculis; sepalis corollæque lobis longissime subulatis, valde pilosis.—In Brasilia: *v. s. in herb. Mus. Brit.*, Maceio (Gardn. 1363).

Its axils are $\frac{3}{4}$ inch apart; the leaves are $2\frac{1}{4}$–$2\frac{3}{4}$ inches long, $1\frac{1}{4}$–$1\frac{1}{2}$ inch broad, on a petiole 5 lines long; peduncle of inflorescence 9 lines long, its two branches 4 lines long, the spicate branches, slightly curved, $1\frac{3}{4}$ inch long; the flowers $1\frac{1}{2}$ line apart; pedicels $\frac{1}{2}$ line long; sepals $1\frac{1}{2}$ line long; tube of corolla $1\frac{3}{4}$ line, the segments $1\frac{1}{4}$ line long; anthers very short, cohering by their apices in the mouth of the tube; pistil $1\frac{1}{2}$ line long; style six times as long as the stigma.

12. *Messerschmidtia minuta*;—Tournefortia minuta, *Bert. in DC. Prodr.* ix. 527;—scandens?, ramis virgatis, junioribus minute puberulis; foliis anguste lanceolatis, obtusis, scabridis, petiolatis: paniculis axillaribus, conjugatim ramosis, ramis spicatifloris; floribus remotis; sepalis lanceolatis, acutis; corollæ tubo medio coarctato, limbi lobis lanceolato-acuminatissimis; drupis 4-gastris.—In Jamaica (*non vidi*).

Leaves $1\frac{1}{2}$ inch long, 3 lines broad.

** Paniculæ in ramis aut in ramulis terminales.

13. *Messerschmidtia microphylla*, nob.;—Tournefortia microphylla, *Desv. in Ham. Prodr.* p. 24 (*non Bert.*); *DC. Prodr.* ix. 528;—Tournefortia lucida, *Desf. Cat. Hort. Par.* p. 397 (*non Desv.*);—subscandens?, undique glaberrima, ramulis tenuissimis, teretibus, lenticellatis; foliis parvis, obovatis, imo rotundatis, a medio gradatim angustioribus, apice valde obtusis, submucronulatis, crassiusculis, obscuris, utrinque rugulosis; petiolo tenui, limbo 6-plo breviore: paniculis in ramulis terminalibus, suboppositifoliis, breviter puberulis,

bis dichotome divisis aut simplicioribus; ramulis spicatifloris, filiformibus; floribus minutis; sepalis corollæque lobis longe subulatis, puberulis.—In Antillis: *v. s. in herb. Mus. Brit.*, ins. S^{a} Cruz (Van Rohr).

This appears to be a slender plant, with somewhat trailing branches $\frac{1}{2}$ line thick, with axils 4–6 lines apart; leaves 7–11 lines long, 5–6 lines broad, on a petiole $1\frac{1}{2}$–2 lines long; the peduncle of the inflorescence is 3 lines long, its two branches 2 lines long, the spicated branchlets 6–12 lines long; the flowers $1\frac{1}{4}$ line long, on a pedicel $\frac{1}{2}$ line long; the sepals somewhat shorter than the tube of the corolla, and its lobes the same length as theirs.

14. *Messerschmidtia volubilis*, Röm. & Sch. Syst. iv. 541; Don, Dict. iv. 370;—Tournefortia volubilis, *Linn. Sp.* 201 (*non R. & P.*); *DC.* (*in parte*) *Prodr.* ix. 523; *Lam. Dict.* v. 358, tab. 95. fig. 2 (*non* 1 *nec* 3); *Gaertn. Fr.* i. 365, tab. 76. fig. 2; *Fresen.* (*in parte*) *in Mart. Fl. Bras.* xix. 53;—scandens, ramulis tenuissimis, fistulosis, rufo-pubescentibus; foliis parvis, lanceolato-oblongis lanceolatisve, acutis, læte viridibus, utrinque scabridule rugulosis, supra laxe pilosis vel subglabris, subtus adpresse puberulis; petiolo puberulo, tenui, limbo 6-plo breviore: paniculis sæpius terminalibus, subpuberulis, bis vel ter dichotome divisis; ramis tenerrimis, valde divaricatis, spicatifloris; floribus breviter pedicellatis, parvis; sepalis laciniisque corollæ lanceolato-subulatis; drupis 4-gastri-globosis, centro depressis, glabris, subdiaphanis, 4-maculatis.—In Antillis: *v. s. in herb. Mus. Brit.* (ex hb. Miller.).

This very slender species is probably confined entirely to the Antilles; but many plants assigned to it should be excluded: Gardner's No. 1785, from Ceará, referred here by Prof. A. DeCandolle, is *M. Salzmanni*; and others included by Prof. Fresenius should in like manner be rejected,—for instance, var. *hirsuta*, from Bahia (Blanchet), and others from Rio de Janeiro (Schott, 4939) (D. 1595). Its branches are scarcely more than $\frac{1}{4}$ line in thickness, with axils 6–7 lines apart; the leaves are 12–15 lines long, 5–6 lines broad, on a petiole 2 lines long; the peduncle is 3 lines long, the primary and secondary branches 3 lines, the ultimate spikes 12–15 lines long. In Gaertner's figure the position of the nucule is reversed: the radicle of the embryo ought to point to the summit.

15. *Messerschmidtia velutina*, G. Don, Dict. iv. 370;—Tournefortia velutina, *H. B. K.* 379, tab. 201; *DC. Prodr.* ix. 524;

—scandens, ramis teretibus, cano-tomentosis; foliis ovato-oblongis, obtusule acuminatis, imo rotundatis aut acutiusculis, crassis, utrinque lanato-tomentosis, subtus albidis; petiolo cano-tomentoso, limbo 6-plo breviore: paniculis terminalibus, dichotomis; ramis plurimis, subalternis, diffuse divaricatis, spicatifloris, cano-tomentosis; floribus unilateralibus, remotiusculis; sepalis lanceolatis, pubescentibus; drupis hispidulis, 4-gastris.—In Mexico, prope Acapulco (*non vidi*).

Axils $\frac{3}{4}$–1 inch apart; leaves 3–3$\frac{1}{4}$ inches long, 13–16 lines broad, on a petiole 6–7 lines long. The terminal panicle is diffusely divided into about ten unilateral spikes, 4–5 lines apart, each about 3 inches long, with sessile flowers 1–2 lines apart.

16. *Messerschmidtia spigelliflora*, nob.;—Tournefortia spigellæflora, *A. DC. Prodr.* ix. 525;—scandens, ramis teneribus, teretibus, fistulosis, patenter rufulo-pilosis; foliis elliptico-oblongis, acuminatis, acute mucronulatis, imo obtusis, membranaceis, utrinque albo-tuberculatis et sparse adpresso-pilosis, supra fusco-, subtus pallide viridulis, nervis tenuibus obscuris; petiolo dense piloso, limbo 12–15-plo breviore: panicula terminali, longiuscula, laxe 3–4-chotome divisa, geniculatim flexuosa, dense pilosa, ramis ultimis curvulis, spicatifloris; floribus crebre 1-seriatis, pilosis; sepalis lobisque corollæ acutissime subulatis.—In Guiana Britannica: *v. s. in herb. meo* (Schomb. 749).

A climbing plant, with slender branches $\frac{1}{2}$–$\frac{3}{4}$ line thick, with axils 1 inch apart; leaves 3–3$\frac{1}{2}$ inches long, 1$\frac{1}{4}$–1$\frac{1}{2}$ inch broad, on a petiole 3 lines long; panicle 5 inches long and broad, with geniculated conjugated divisions widely spreading, three times dichotomously divided; peduncle 1 inch long; primary branches 6–20 lines, secondary 9 lines, spicated branches 1$\frac{1}{2}$ inch long; sepals 1$\frac{1}{4}$ line long, tube of corolla narrow, straight, 3 lines long, lobes of border 1 line long; anthers included, cohering at their summits; style elongated, turbinately thickened at its apex, and surmounted by a rather long, obtuse, pilose stigma.

17. *Messerschmidtia membranacea*, Gardn. Lond. Journ. Bot. i. 181;—Tournefortia membranacea, *DC. Prodr.* ix. 530;—Tournefortia floribunda, *Fresen.* (*non H. B. K.*) *in Mart. Fl. Bras.* xix. p. 54;—scandens, ramis compressis, flexuosis, subfistulosis, ferrugineo-tomentosis; foliis ovato-oblongis, imo rotundatis aut subcordatis, apice acutis et breviter mucronatis, supra pilis brevibus rigide adpressis incanis crebre tectis, subtus pallidioribus, densius velutinis, in nervis costa-

que flavido-tomentosis; petiolo tomentoso, limbo 5–6-plo breviore: paniculis axillaribus et terminalibus, flavo-tomentosis, bis dichotome geniculatim divisis, ramis ultimis spicatifloris; floribus 1-seriatis, crebre sessilibus; sepalis laciniisque corollæ valde subulatis, tubo superne inflato; drupis 4-gastris, glabris.—In Brasilia: *v. v.* in prov. Rio de Janeiro, ad Botofogo; *v. s. in herb. variis*, ex eodem loco (Gardn. 82).

Prof. Fresenius makes this plant identical with Kunth's *Tournefortia floribunda*, which does not belong to *Messerschmidtia*; it differs in its compressed flexuous subfistulose branches, its acute (not acuminated) leaves, covered with short rigid hairs (not slenderly pubescent nor cano-tomentose beneath); it differs also in its longer style and stigma. In Kunth's plant the drupe is globular, containing four globose nucules. In this species the flattened branches are $1\frac{1}{2}$ line broad, with axils 1–$2\frac{1}{2}$ inches apart; the leaves are $2\frac{1}{2}$ inches long, $1\frac{1}{2}$–$1\frac{3}{4}$ inch broad, on a petiole 4–6 lines long: the panicle, widely expanded, is 4 inches long, on a peduncle 6 lines long; primary and secondary branches 9 lines long, tertiary spicated, 3–6 lines apart, each 9–18 lines long; sepals $\frac{1}{2}$ line long; tube of corolla less than 1 line long, the rest all conformable to the generic character; drupes glabrous*.

18. *Messerschmidtia Salzmanni*, nob.;—Tournefortia Salzmanni, *DC. Prodr.* ix. 524; *Fresen. in Mart. Fl. Bras.* xix. p. 51;—scandens, ramis teretibus, fistulosis, subflexuosis, simplicibus aut breviter ramulosis, flavide aut ferrugineo-tomentosis, axillis subnodosis; foliis oblongo-lanceolatis vel lanceolatis, sensim acuminatis, imo rotundatis, supra pilis brevibus velutino-tomentosis, subtus pallidioribus, ferrugineo-tomentosis; petiolo superne canaliculato, dense ferrugineo-pubescente, limbo 9–10-plo breviore: paniculis in ramulis alaribus terminalibus, flavo vel ferrugineo-tomentosis, bis dichotome divaricato-divisis, ramis conjugatis vel simplicibus, ultimis spicatifloris; floribus remotiusculis, brevissime pedicellatis; sepalis laciniisque corollæ longe subulatis.—In Brasilia, prov. Bahia (Blanchet, 3787–3789, et Claussen, 412–419); *v. s. in herb. meo*, Ceará (Gardner, 1785); *in herb. Mus. Brit.*, Bahia (Luschnatt).

A plant with long tortuous scandent branches, with axils $\frac{3}{4}$–2 inches apart; leaves $2\frac{1}{4}$–$3\frac{1}{2}$ inches long, 1–$1\frac{1}{4}$ inch broad, on a petiole 3–4 lines long; peduncle of inflorescence 5 lines,

* A drawing of this plant, with sectional details to show the generic structure, will be given in the second volume of my 'Contributions,' Plate 53 B.

two primary divaricating branches 6 lines long, bearing five alternate floriferous spikes 3 lines apart, 12–20 lines long; sepals ½ line, tube of corolla 1¼ line, segments 1 line long; anthers included, cohering by their summits; ovary glabrous; style slender, incrassated at the apex, and surmounted by a pilose elliptical stigma; drupes much depressed, deeply 4-lobed, 1½ line in diameter, glabrous, the nucules incurved, dorsally tuberculated.

*** Paniculæ terminales et subpyramidatæ.

19. *Messerschmidtia candidula*, nob.;—Tournefortia sericea, *DC.* (*non Vahl*) *Prodr.* ix. 524; *Fresen. in Mart. Fl. Bras.* xix. 54;—scandens, ramulis rectiuscule elongatis, teretibus, subfistulosis, molliter cano-tomentosis; foliis ovatis, brevissime acutis, imo rotundatis aut subcordatis, supra dense viridibus, rugulosis, sparse molliter sericeo-villosis, in nervis sulcatis, subtus dense albo-lanato-tomentosis; petiolo tomentoso, limbo 20-plo breviore: panicula terminali, anguste pyramidata, albo-tomentosa, alternatim breviter ramosa, cum ramulis brevissimis et approximatis, paucifloris; floribus minusculis, crebris, obsolete pedicellatis; sepalis corollæque laciniis lineari-setaceis, pubescentibus, tubo imo glabro, superne densissime villoso; drupis depresso-globosis, 4-gastris, pilosis.—In Brasilia: *v. s. in herb. meo*, Ceará (Gardn. 1078).

This plant has been referred to the *Tournefortia sericea* of Vahl, a species from the Antilles, known only from his short description. It differs from it in its leaves not being glabrous above, and being nearly sessile, in its much denser terminal and pyramidal inflorescence (not axillary and dichotomously divided). Its branches are nearly straight and simple, 1½ line thick, with axils ¾–1½ inch apart; the leaves are 1¾–2 inches long, 1–1¼ inch broad, on a petiole scarcely more than 1 line in length. The terminal inflorescence is not pedunculated, 2½ inches long, 1 inch broad, consisting of many alternate branches 1–2 lines apart, each with very crowded short floriferous branchlets 2–4 lines long; flowers on very short pedicels, crowded; sepals 1½ line long; tube of corolla 1¼ line long, lobes of border ½ line long; anthers cohering at their apex; the style, thickened at the summit, including the stigma, is ¾ line long; the drupe in its structure quite conforms to the generic character.

20. *Messerschmidtia villosa*, nob.;—Tournefortia villosa, *DC. Prodr.* ix. 524; *Fresen. in Mart. Fl. Bras.* xix. p. 52;—ramis teretibus, hirsutissimis; foliis ovatis, acuminatis,

supra sparse pilosis, subtus conferte fulvo-sericeo-villosissimis, petiolatis : paniculis terminalibus, divaricato-dichotomis, aut in ramis axillaribus 1-foliosis, divaricato-dichotomis, fulvo-hirsutissimis ; sepalis laciniisque corollæ longe subulatis, villosis, tubi apice villosissimo.—In Bahia (Blanchet, 215, 821, 1151, 2202) (*non vidi*).

The leaves are $1\frac{5}{8}$–$2\frac{5}{8}$ inches long, 1–$1\frac{1}{2}$ inch broad, on a petiole 3 lines long ; sepals 2 lines long ; tube of corolla 3 lines long.

21. *Messerschmidtia subsessilis*, Don, Dict. iv. 370 ;—Tournefortia subsessilis, *Cham. Linn.* viii. 119 ; *DC. Prodr.* ix. 521 ; *Fresen. in Mart. Fl. Bras.* xix. p. 53 ;—scandens, ramulis tenuiter rectiusculis, teretibus, rigidule ferrugineo-tomentosis ; foliis divergentibus, elongato-obovatis, acute acuminatis, imo subrotundatis, utrinque ruguloso-punctatis, e tuberculis sparsim adpresse pilosis, nervis supra impressis, subtus costaque prominulis, fulvo-pilosis ; petiolo tenui, rufo-piloso, limbo 15-plo breviore : panicula terminali, subpyramidata, alternatim breviter laxe ramosa, ramis inferioribus rufo-pilosis, imo pluribracteatis, superne ramulos 4 alternos spicatifloros ebracteatos gerentibus, superioribus cum ramulis conjugatis floriferis, aut simpliciter spicatifloris ; floribus pedicellatis ; sepalis corollæque laciniis longe subulatis, pilosulis, tubo fauce contracta.—In Brasilia : *v. s. in herb. Mus. Brit.*, Pernambuco (Gardn. 1076).

The above plant agrees with Chamisso's description of this species : it is nearly allied to *M. Pohlii*. The slender branches have the axils 6–9 lines apart ; the leaves are 2–$2\frac{3}{4}$ inches long, 11–14 lines broad, on a petiole 2 lines long. The terminal inflorescence is 3 inches long ; the alternate branches, 2–4 lines apart, are about an inch long ; the pedicels are $\frac{1}{2}$ line long ; the sepals 1 line long ; the tube of the corolla $1\frac{1}{4}$, the segments $\frac{3}{4}$ line long.

22. *Messerschmidtia Pohlii*, nob. ;—Tournefortia Pohlii, *Fresen. in Mart. Fl. Bras.* xix. p. 52 ;—scandens, ramis subcompressis, fistulosis, rufo-pilosis ; foliis ovatis vel oblongis, acute acuminatis, imo rotundatis, supra tomentosis, nervis flavo-pubescentibus, subtus rufescenti-tomentoso-velutinis ; petiolo tomentoso, limbo 10-plo breviore : panicula terminali, pyramidata, alternatim divaricato-ramosa, ramis simplicibus et spicatifloris, aut iterum brevissime ramulosis, ramo inferiore sæpe 1-folioloso ; floribus sessilibus, dense villosis ; sepalis corollæque laciniis longe subulatis ; drupis 4-gastris, glabris.—In Brasilia : *in herb. Imp. Vindob.* (Pohl,

3535); *v. s. in herb. Mus. Brit.*, mont. Organens. ad Imbuhy (Gardn. 546).

A very distinct species, having straight elongated branches, with axils 1½ inch apart; leaves 1½–3¾ inches long, ¾–2 inches broad, on a rather stout petiole 2–3 lines long; the terminal panicle is 6 inches long in flower, 8 inches long in fruit, with twenty to twenty-four alternate patent branches 4–6 lines apart, 1–2 inches long, diminishing upwards, bare at base, the lower ones again branched, the upper ones simply spicate; flowers 1 line apart; sepals rather fleshy, very pilose on both sides, 1¼ line long; tube of corolla fleshy, contracted in the middle, 1½ line long, its segments ¾–1 line long; anthers cohering in the mouth by their scabrid summits; ovary and style equal, glabrous; stigma short, conical, pilose, sub-2-lobed.

XX.—*On a point relating to the Histology of* Rhynchonella.

By Professor W. King.

To the Editors of the Annals and Magazine of Natural History.

Glenoir, near Galway,
August 10, 1868.

Gentlemen,

Dr. Carpenter, according to his letter inserted in the 'Annals' of this month, has taken it upon himself to "think that the scientific world has a right to know" my "present opinions" on a number of points, which he has written out, pertaining to the genus *Rhynchonella* and some other shells. As regards most of these points, it strikes me that I am not by any means required to notice them: there is one, however, on which, considering the way in which it is represented by Dr. Carpenter, I feel myself called upon to say a few words.

It is quite correct that "some twenty years ago" I was led "to believe that certain very minute dark points, which I observed here and there dispersed over the surface of the valves of various fossil species, were the remains of orifices belonging to extremely minute perforations," and consequently to "doubt the absence" of a perforated structure in any palliobranchiate shell. Now it so happens that ample evidence has long been published by which the "scientific world" is enabled to judge of my "present opinion" on the subject to which my "doubt" applies. In a paper of mine, entitled "Notes on Permian Fossils," which appeared in the 'Annals' of April 1856, I inserted a footnote, containing some remarks on the histology

of *Rhynchonella*, &c., and concluding with the following passage:—

"But let me not forget to acknowledge that I was in error in doubting the absence of perforations 'in any Brachiopod whatever:' the account which Dr. Carpenter has given of *Rhynchonella psittacea* in his late chapter* is quite conclusive on this point; but I cannot help thinking, from their occurring in *R.? Geinitziana*†, that perforations will yet be found in congeneric species supposed, or stated, to be without them"‡.

The way Dr. Carpenter writes with reference to my voluntarily acknowledged error, also the other "remarks" he has indulged in in his letter, will, I feel assured, be quite sufficient to convince the "scientific world" that, for anything more he can adduce, the "main question" (*i. e.* the "remarkable fact incontestably established") at issue between us is, as far as we are mutually concerned, now closed,—that, if kept open, it would inevitably degenerate into a mere personal dispute, redundant of reticences, and bolstered up with no end of irrelevant matter.

Yours very truly, &c.

William King.

XXI.—*On the Law of Development of the Sexes in Insects.* By Professor Von Siebold§.

The assertion made by Landois in his preliminary communication¶ that the eggs laid by insects possess no definite traces of the sexual organs, and that the sex of the larvæ is only developed as male and female after their escape from the egg-shell by the influence of difference of food received from without, will not only possess the highest interest for all naturalists who attend to the reproductive history of organic bodies, but, as Landois applies this theory specially to the reproduction of

* Reference is here made to Dr. Carpenter's memoir "On the Intimate Structure of the Shells of Brachiopoda," appended to Mr. Davidson's Monograph of Brit. Foss. Brachiopoda: Introduction. A perusal of my footnote will explain the reason why I only referred to Dr. Carpenter's "late chapter."

† The presence of perforations in this species has caused me to regard it as the type of a new genus (*Rhynchopora*) of the family Rhynchonellidæ.

‡ See Ann. & Mag. Nat. Hist. ser. 2. vol. xvii. p. 337. Even in June (Geological Magazine) of last year I again drew attention to this point, acknowledging "the mistake I made in asserting that certain imperforate Palliobranchs are perforated," and in "concluding that all Spiriferidæ are perforated."

§ Translated by W. S. Dallas, F.L.S., from the Zeitschrift für wissensch. Zoologie, Band xvii. pp. 525–532.

¶ See Zeitschrift für wiss. Zool. xvii. p. 375, and Ann. & Mag. N. H. ser. 3. vol. xix. p. 224.

bees, must also produce considerable excitement among the breeders of bees, as Landois in so many words completely denies the existence of the very peculiar parthenogenetic circumstances under which the male bees are developed from the eggs.

Landois appeals to his repeatedly successful experiments by which he thinks it is proved that all the eggs laid by a normal queen are fertilized by her, that in consequence of this fertilization the development of the larvæ in the eggs takes place, and, further, that these larvæ when just hatched from the egg do not yet possess any definite indications of sex. The sex of bees is rather [according to him] only fixed as male or female by the difference of nourishment taken from without, according as the workers furnish drone-food to those larvæ in the drone-cells, or worker-food to those in the worker-cells.

Landois transferred the bottom of a drone-cell, furnished with an egg, into a worker-cell, and *vice versâ* the egg-bearing bottom of a worker-cell into a drone-cell; and by this means from the egg destined by the queen to become a worker, the larva from which in consequence of this transfer was nourished with drone-food, he obtained a drone, whilst from the egg destined by the queen to become a drone, the larva of which in consequence of a similar substitution was brought up on worker-food, a worker was produced.

Whether no error or illusion can occur in these experiments must be decided by practised and experienced bee-keepers, to whom I particularly recommend the repetition of this experiment. For my part I can only appeal here to those results which are to be obtained by anatomical and microscopic investigations of the larvæ of insects in course of development within the egg. Taking these into consideration, I feel compelled to express the greatest doubt as to the correctness of the new theory set up by Landois.

From the very careful investigations of various reliable observers in the domain of the developmental history of insects, we know that, even in the egg, simultaneously with the development of the different systems of organs of an insect-larva, the sexual organs also begin to be formed, and even become differentiated to such a degree that in a larva which has just escaped from the egg-shell we are already able to distinguish the male or female sex from the difference in form of the first rudiments of the inner reproductive organs.

Herold, the well-known insect-anatomist, obtained the following results from his accurate investigations of the development of the cabbage-butterfly* :—The organs which

* See his 'Entwickelungsgeschichte der Schmetterlinge,' Kassel und Marburg, 1815, p. 1.

are produced by the formative power from the fluid of the egg are, a nervous system, a muscular system, an air-vessel system, and an alimentary system, together with the salivary and biliary vessels belonging to the latter,—also a pair of excretory organs (namely, the spinning-vessels), a dorsal vessel, and, lastly, the germs of undeveloped reproductive organs, with a *perfectly distinctly visible distinction of the two sexes.* On the fifth plate of the above-mentioned work he gives an exceedingly instructive and true view of the germs of the reproductive organs of both sexes, as these gradually enlarge from the first formation of the cabbage-caterpillar in the egg up to its full growth and approach to transformation. In fig. 1 he shows the two reniform corpuscles divided by three constrictions into four sections lying one behind the other (the future testes), with two filaments issuing from them laterally (the future efferent ducts), from a male caterpillar which had crept out of the egg a few hours before; whilst in fig. 2 of the same plate we may recognize the two bud-like corpuscles, with four laterally approximated sausage-like divisions and two fine filaments springing from behind, as the future ovaries and oviducts of a female caterpillar of similar age. I will not, however, conceal that Hermann Meyer, of Zurich, did not succeed* in finding the sexual parts in caterpillars which were only a few days old; on the other hand, Weismann, in his remarkable work on the embryology of insects† completely affirms the correctness of the observations first made by Herold in butterflies of the occurrence even in the embryo of the germs of the sexual glands with distinctly visible distinction of the sex, inasmuch as he could likewise distinguish the rudiments of the sexual glands in the embryos of flies in the egg, although the difference between the germs of the male and female sexual glands is much less striking. In the investigation of a Tipulide larva, however, Weismann obtained other results, which I must not pass over. When he sought the genital glands in the embryos of *Corethra plumicornis*‡, he certainly convinced himself that in this insect also, as in the larvæ of the true flies, the sexual glands are already traced out in the embryo; but he found that in the larvæ of *Corethra* just escaped from the egg the distinction is as yet by no means clear, and this distinction does not make its

* "Ueber die Entwickelung des Fettkörpers, der Tracheen und der keimbereitenden Geschlechtstheile bei den Lepidopteren," Zeitsch. für wiss. Zool. Bd. i. p. 177.

† "Die nachembryonale Entwickelung der Musciden nach Beobachtungen an *Musca vomitoria* und *Sarcophaga carnaria*," ibid. Bd. xiv. p. 219.

‡ Die Metamorphose der *Corethra plumicornis*, ibid. Bd. xvi. p. 99.

appearance in a marked manner until after the fourth change of skin. From Mecznikow's very accurate embryological investigations on insects, it appears also that although the tracing out of the sexual glands takes place very early in all embryos of insects, their further development does not advance at an equal rate in all such embryos; so that it is only in certain insects that the differentiation of the sexual organs occurs very early, and, indeed, already in the embryo, whilst in other insects, on the contrary, it is postponed, and takes place only in the excluded larvæ. In the very young larvæ of *Simulia*, just escaped from the egg, Mecznikow* observed a small round genital rudiment, and concluded from this that the rudiments of the sexual organs are formed in the larvæ within the egg. The same author recognized, even at the first formation of the embryo in the viviparous Aphides, the first rudiments of the sexual apparatus as the so-called genital hill†. During the further development of the embryo, and indeed very early, this genital rudiment becomes differentiated into ovarian tubes, in which so-called *pseudova* are likewise very soon developed; so that even during the embryonal life of the aphis-embryo the development of the new generation commences, and goes so far that in the embryos ready to be born two germ-chambers occur in each ovarian tube, of which the lowest already encloses an embryo in the first stage of its development‡. In *Aspidiotus Nerii*, on the contrary, Mecznikow§ could not find any genital hill so early produced and differentiated into ovarian tubes, such as he had succeeded in discovering in the Aphides.

From these known circumstances in the first development of the reproductive organs of insects it appears that differences occur in it, and that in a certain series of insects the differentiation of the sexual apparatus occurs in the embryos while still enclosed in the egg-shell, whilst in other insects this differentiation only takes place after the exclusion of the larvæ. Landois's theory can certainly find no application to the insects belonging to the first series—namely, the Lepidoptera and Flies (*Muscidæ*); in the second series, in which *Corethra*, *Simulia*, and *Aspidiotus* are to be placed, it may be possible that the still rudimentary and indifferent sexual glands of the larvæ are further developed in accordance with the male or female type, under the influence of the incepted nourishment. When, and in what manner in the larvæ of the bees the first

* "Embryologische Studien an Insecten," Zeitsch. für wiss. Zool. Bd. xvi. p. 405.

† Ibid. p. 444, pls. 28 and 31. figs. 15–37, and p. 458.

‡ Ibid. p. 459, pl. 31. fig. 46. § Ibid. p. 473.

rudiments and the definite differentiation of the sexual glands appear, we have no direct investigation to show. I earnestly recommend such investigation to entomologists for the solution of the question before us. Leuckart, however, has already given an indication in this direction *, when he says, "on the sixth day I find in the female larvæ the first traces of internal genitalia."

With regard to the above-mentioned discovery of Mecznikow's, of the development in the embryos of the viviparous Aphides of ovaries in the germ-chambers of which the formation of a new generation was already commenced, M. Landois has informed me, by letter under date of the 6th May, that he has succeeded by the gradual application of artificial cold, and during the withering of their food-plants, to cause the disappearance of the viviparous Aphides (the so-called *Nurses*), and the appearance in their place of the sexual generation consisting of males and ovipositing females. I cannot doubt this result which Landois has obtained from his experiments; but I will take the liberty of putting the question, How, in this case, does the production of the two sexes simultaneously with the existence of scanty nourishment agree with the new theory set up by Landois?

From his experiments on bees, Landois draws the conclusion that the development of female and male bees is induced, independent of the fecundation or non-fecundation of the ova, only by difference of the food supplied to the larvæ—abundant nourishment producing females, and scanty nourishment males. According to the observations and statements of our most experienced observers of bee-life, this opinion, expressed by Landois as to the different feeding of the larvæ of bees, is not correct. All writers who have treated of the rational management of bees agree in this, that the *whole of the larvæ* in the earliest period of their life (up to the sixth day) receive the *same nutriment*, namely, food-paste (digested chyle-paste), with which the larvæ destined to become queens are fed, abundantly and uninterruptedly, until their change to the pupa state; whilst the *larvæ of the workers and drones* afterwards (from the sixth day) receive, instead of chyle-paste, a coarser sort of food prepared from undigested honey and pollen†.

* Bienenzeitung, 1865, p. 210.

† To indicate only a few of the many authorities who have expressed themselves concordantly as above with regard to the feeding of the larvæ of bees, I cite the following:—

Leuckart: "Ueber die Nahrung der Bienen im ausgebildeten Zustande und während des Larvenlebens," Bienenzeitung, 1855, p. 207.

Berlepsch: 'Die Biene und die Bienenzucht,' 1860, p. 102.

Klein: 'Die Biene und ihre Zucht,' 1864, p. 29.

This identity of the nourishment of the young brood of the workers and drones seems to have been entirely overlooked by Landois. A difference between the food of the drones and workers, such as Landois lays so much stress upon, does not exist. As, from the observations of our most experienced breeders of bees, the workers are able to rear a queen from a worker larva before it is six days old, and as the workers can, by means of royal food, procure a queen from every egg normally deposited in a worker-cell, but not from an egg normally deposited in a drone-cell, it follows, as a matter of course, that in bees the sex is definitely fixed beforehand even in the egg by the effectuation or omission of fecundation, and not merely defined by the difference of the food of the larva.

The development of the eggs laid by unfertilized queens, from which, according to the experience of all observant bee-keepers, only drones are produced, is not regarded as parthenogenesis by Landois; at least the term "parthenogenesis" is avoided by him, although he speaks of a primary and a secondary drone-broodedness, the cause of which is thus explained by him: "that eggs are laid by queens or workers, which are furnished with *scanty formative materials*, from which *weakly larvæ* must be developed, and consequently drones."

Whence does Landois conclude that these eggs laid by drone-brooded queens and workers are furnished only with scanty formative materials? By what investigation has Landois arrived at the knowledge that from such eggs weakly larvæ, and consequently drones, must be developed? Has Landois convinced himself by careful observation and exact dissection of such drone-mothers of the absence of male semen in their sexual organs? Our scientific bee-keepers could state with regard to a great number of drone-brooded queens, with certainty, that they had remained unfecundated, and that they consequently laid unfertilized eggs, but, as experience has proved, capable of development, from which, whether deposited in drone- or worker-cells, only drones are developed. The dissection of such drone-mothers, which has been often enough undertaken by people well acquainted with the subject, has always proved that the seminal receptacle, whether normally developed or rudimentary, contained no trace of male semen.

As Landois refers to the fact that, with regard to the proposition that "drones always proceed from unfertilized eggs,"

Schmid und Klein, 'Leitfaden für den Unterricht in Theorie und Praxis einen rationellen Bienenzucht,' 1865, p. 26.

Vogel, 'Praktisches Handbuch der Bienenzucht,' 1866, p. 99.

Dzierzon himself doubted his own theory, because, in the experiments on intercrossing German and Italian bees, remarkable and inexplicable phenomena occurred which could not be brought into harmony with Dzierzon's theory, I must appeal to the arguments which I have already urged against this doubt of Dzierzon's*.

Landois states that by taking very young larvæ of *Vanessa urticæ* and feeding them imperfectly he reared from them only males, and by feeding them abundantly only females. This assertion is in complete contradiction to the phenomenon which may be observed in *Polistes gallica* with regard to the production of the sexes. Every female of *Polistes* fecundated in the autumn, after passing through its winter-sleep, founds a separate colony at the commencement of the spring; it makes a comb for itself, furnishes the cells of this with eggs, and then, still quite alone, feeds the larvæ produced from these eggs until they are full-grown. From these larvæ the so-called workers (that is to say, small female individuals) are always developed; male individuals are never bred in the months of June and July; and it is only in August that the first males issue from the operculated cells of these colonies of *Polistes*. According to Landois's theory, the larvæ reared by the solitary *Polistes* mother ought to furnish males, as this brood is usually very scantily provided with nourishment, and indeed often left for a considerable time without food by their mother, which has to complete the business of feeding them without any assistance. This starvation of the brood of *Polistes* occurs when the temperature becomes cold, when the sky is overcast, and during rain and wind; for when the weather is unfavourable, even if this lasts for several days, the females of *Polistes* remain uninterruptedly inactive, concealed behind their combs. As no supply of food is laid up in the combs of *Polistes*, but the nourishment is always poured from mouth to mouth by the Wasp into the larvæ, the scarcity of food often causes the development and growth of the larvæ to go on very slowly and with interruptions. According to Landois, all these circumstances ought especially to favour the development of male individuals; but until a large number of workers (which, as larvæ, certainly do not revel in a superabundance of food) have been excluded to assist the mother, no male individuals of *Polistes* are developed.

In order to give more currency to the assertion that in those insects the larvæ of which are developed in their food a disproportionate number of females are developed, Landois refers

* Wahre Parthenogenesis bei Schmetterlingen und Bienen, 1856, p. 92. (English translation, p. 74.)

amongst other instances, to a great number of Dipterous genera the larvæ of which wallow in the excess of their food, and mentions that, out of 403 species of these Diptera, Meigen knew only the females of 255. But these examples cannot be adduced as in the least in favour of Landois's theory; for Meigen, in his well-known 'Systematische Beschreibung der europäischen zweiflügeligen Insekten,' very frequently, by his own admission, had only a *single* female and also very often only a *single* male in his hands as the type of the descriptions of his species. Such scanty material as this is certainly insufficient to prove the predominance of one sex over the other.

XXII.—*On some new Species of* Oliva.

By F. P. Marrat.

In selecting the following shells and describing them as new species, I have been guided principally by prominent features in each case, that, in my opinion, warrant the selection and publication.

Oliva lignaria, Marrat, is very remarkable: at one time I supposed it might be a variety of *O. inflata*, Lam.; at another its resemblance to *O. maura*, Lam., appeared to be considerable; and at a third it was, until compared, thought to be a variety of *O. irisans*, Lam. It may prove to be a variety of any one of these three shells when specimens are obtained showing the gradual variation; but at present a shell possessing such connecting characters is still to be brought under notice.

O. sabulosa, Marrat.—The specimens of this shell are described as having red-brown markings. I think, in most if not in all cases, the original colour has been dark brown, and that bleaching in the sun has produced the red-brown colour, notwithstanding one of the shells is brilliantly polished and possesses all the appearance of a dredged shell.

I am much surprised that a shell of rather common occurrence and so decidedly distinct as *O. angustata*, Marrat, should have remained so long unnoticed by conchologists. Years ago its form was familiar to me among the shells imported in the boxes from China.

1. *Oliva lignaria*, Marrat.

Shell cylindrically oblong; spire depressed, callous; suture-edge dotted; colour drab, with dark-brown interrupted bands and angular lines, shaded with purplish spots and dotted lines; the whole interior of the aperture of a uniform purple brown; folds very prominent, one or two tinged

with brown; plaits numerous, indistinct; canal edged with brown.

Borneo.

About the size of a small *O. maura*.

2. *Oliva sabulosa*, Marrat.

Shell oblong fusiform; spire flatly conical; whorls rounded, callous; colour yellowish white, with small red-brown spots and two interrupted letter-like bands; columellar plaits prominent, continued nearly the whole length; interior of the aperture and columella cream-coloured; basal folds broad and raised.

Locality unknown.

Larger than *O. tricolor*, Lam., or *episcopalis*, Lam., with the spiral whorls peculiarly rounded and callous.

3. *Oliva angustata*, Marrat.

Shell narrowly cylindrical; spire slightly raised, canaliculate, edged with small rather close dots; colour pale yellow, with two brown interrupted bands and small pale dots; columella plaited more than midway, with two or three broad folds at the base; interior of the aperture bluish white.

China.

Most nearly allied to *O. neostina*, Duclos, but is smaller, narrower, and differs in the folds and columellar plaits.

4. *Oliva nota*, Marrat.

Shell ovate fusiform, rather inflated; spire considerably exserted, canaliculate; suture with large brown blotches; white, with broad wavy brown lines, which become darker about the belt; belt white; columella rounded, basal band white; a single deep-purple fold at the base; the pattern of the shell is seen through in the interior.

Locality unknown.

Not like any other species known to me. Size $\frac{4}{10}$ inch by $\frac{1}{10}$ inch.

5. *Oliva exilis*, Marrat.

Shell narrowly fusiform; spire elongate conical, canaliculate; colour white, with pale yellow-brown reticulated markings; beneath the spire and basal band white; columella callous, with five or six very strong plaits at the base; interior of aperture white.

South America.

This is a third species belonging to the genus *Lamprodoma* of Swainson. Size, similar to the last.

6. *Oliva pulchra*, Marrat.

Shell fusiform, rather narrow; spire conical, whorls slightly flattened; suture canaliculate; pale cream-coloured, with brown festoons below the suture; body-whorl with irregular brown longitudinal flames, spotted above the white basal band; columella slightly granular, with a single fold at the base.

Among some shells from California; but the locality is doubtful. A small shell, not larger than *O. oryza*, Lam.

XXIII.—*On a new Genus of Gastrotrichous Rotatoria.*

By E. Claparède*.

The genera *Chætonotus*, Ehrb., and *Ichthydium*, Ehrb., have hitherto occupied only an uncertain place in the zoological system. M. Ehrenberg joined them to *Ptygura* and *Glenophora* to form a family of Rotatoria; Dujardin considered them to belong to the Infusoria; M. Vogt classes them in a general way among the Vermes; M. Schmarda makes them almost Annelides; M. Ehlers even approximates them to the Nematoida. The opinion most generally accredited is that which regards them as Turbellaria. M. Max Schultze was the first to develope this opinion when he made known, under the name of *Turbanella*†, a new genus belonging to the same group. The two authors who have most carefully studied these interesting animals of late are Mr. Gosse‡ and M. Mecznikow §.

The former, in making known several new species, avoids pronouncing an opinion on the natural position to be assigned to the family Chætonotides (Hairy-backed animalcules, as he calls them). It was, indeed, very difficult for him to form a judgment, on account of the unfortunate union with this family of two dissimilar genera, namely, *Taphrocampa*, Gosse, and *Echinoderes*, Duj. Now the *Taphrocampæ* are, as I have already demonstrated, true Rotatoria. As to *Echinoderes*, it has no affinities with either the Rotatoria or the Turbellaria. The mistake of Mr. Gosse with regard to them is easily ex-

* Translated from the 'Annales des Sciences Naturelles,' 5e sér. tome viii. pp. 16–23.

† Beiträge zur Naturgeschichte der Turbellarien, von Dr. Max Sigismond Schultze, (Greifswald) p. 69.

‡ "The Natural History of the Hairy-backed Animalcules" (Intellectual Observer, 1864, pp. 307–406).

§ "Ueber *Chætonotus* und *Icthydium*, und eine neue verwandte Gattung *Turbanella*," Müller's Archiv, 1853, p. 241.

plained, as that naturalist only knew *Echinoderes* from a bad figure of Dujardin's. After the recent investigations on this singular type, Mr. Gosse would no longer think of approximating it to *Chætonotus*.

M. Mecznikow* not only describes several species hitherto unknown, but also makes known, under the names of *Chætura* and *Cephalidium*, two very remarkable new genera evidently nearly allied to the preceding. This naturalist reviews all the previously expressed opinions as to the zoological position of this singular group; he discusses them carefully, and ends by rejecting them. He himself resolved to erect the genera that we have enumerated into an order apart, under the name of *Gastrotricha*, an order which would form with that of the Rotatoria a peculiar class in the subdivision of Vermes. Finally, therefore, the *Ichthydinia* (for that is the name which has been most generally given to them), after having been tossed about in every direction on the ocean of classification, return to drop anchor nearly at their starting-point.

The opinion maintained by M. Mecznikow† has a good deal in its favour. In any case, I accept his order of Gastrotricha, characterized essentially by the clothing of vibratile cilia on the ventral surface of the body, and also by some other secondary characters, such as the absence of jaws &c. The affinity of this order with the Rotatoria also appears to me to be incontestable. The convenience of uniting all these animals in one class will then be the only subject of discussion. We know, moreover, that naturalists are still divided in opinion on the subject of the natural position to be assigned to the Rotatoria.

Putting on one side the latter question, we find the order of the Gastrotricha composed at present of six genera, namely, *Chætonotus* (Ehrb.), *Ichthydium* (Ehrb.), *Chætura* (Meczn.), *Cephalidium* (Meczn.), *Dasydites* (Gosse), *Turbanella* (Schlz.)‡.

* "Ueber einige wenig bekannte niedere Thierformen, von Elias Mecznikow," Zeitschr. f. wiss. Zoologie, 1865, Bd. xv. p. 450.

† 'Beobachtungen über Anatomie und Entwicklungsgeschichte wirbelloser Thiere and er Küste von Normandie angestellt von Dr. E. Claparède,' Leipzig, 1863, p. 90, pl. 16. figs. 7–16; and "Bemerkungen über Echinoderes von Elias Mecznikow" (Zeitschr. f. wiss. Zoologie, 1865, Bd. xv. 4tes Heft, p. 458). In the work cited I described two species under the names of *Echinoderes Dujardinii* and *E. monocereus*. A year later, without knowing of my observations, Mr. Gosse renamed the former of these species; but as he likewise dedicated it to Dujardin, this does not cause any inconvenience in synonymy. Mr. Gosse writes it *Echinodera*, and not *Echinoderes*.

‡ It is just to say that M. Perty, without discussing the question with the same care as M. Mecznikow, nevertheless arrived at nearly the same

All these genera consist at present only of freshwater species. It is therefore interesting to make full acquaintance with a marine form, which certainly differs much from the types hitherto described, so that I have been obliged to form for it a new genus, which I will characterize further on under the name of *Hemidasys**.

Hemidasys agaso lives abundantly in the most muddy parts of the port of Naples; hence its specific name (*agaso*, groom). For a long time I regarded it as an epizoon. The surest means of procuring it is to examine carefully the specimens of *Nereilepas caudata* (*Spio caudatus*, Delle Chiaje). We soon meet with some individuals bearing one or two specimens of *Hemidasys*: these are fixed by their posterior extremity between the feet of the Annelide. Their body, which is very contractile, elongates and contracts alternately, the anterior extremity feeling rapidly about in all directions, to seek its nourishment among the setæ of the *Nereilepas*. Their movements resemble those of many of the Rotatoria. In attentively examining the mud, we find several free *Hemidasyes*; their being parasites, therefore, is only occasional or accidental. I have, however, never met with *Hemidasys* on other Annelides in the mud except *Nereilepas*.

Hemidasys agaso attains a length of 0·3 to 0·5 millim., with an average breadth of 0·12 millim. Its form is that of a small band, or thick strap, with nearly parallel margins. In general it is more flattened than most of the other Gastrotricha. The surface of the body is formed by a delicate cuticle separated from the adjacent parenchyma by a stratum of liquid of a slight rose-colour. The colour of this liquid is probably due to a simple effect of contrast, like that of the vacuoles and the contractile vesicles in the Infusoria. The liquid stratum is traversed by a great number of little bands, which pass directly from the parenchyma to the cuticle. At the point where it is attached to the latter, each band dilates a

result. ('Zur Kenntniss kleinster Lebensformen nach Bau, Function, Systematik, &c., von Dr. Maximilien Perty,' Bern, 1852, p. 35.)

* M. Mecznikow also mentions the genus *Sacculus*, Gosse. On the other hand, the Russian naturalist does not mention *Dasydites*, Gosse, the diagnosis of which nevertheless dates back to 1851 (Ann. & Mag. Nat. Hist. Sept. 1851). In any case the genus *Sacculus* has nothing to do here. It was, it is true, classed originally among the Holotricha, Ehrb.; but this not very natural order contains, besides some Gastrotricha, certain true Rotatoria. The *Sacculi* have a mastax with two hammers and an incus. Their males are destitute of digestive apparatus; in short, they are true Rotatoria in all points. M. Mecznikow certainly did not know them when he enumerated them among the Gastrotricha. Mr. Gosse, moreover, in his recent work on this group makes no mention of them.

little, and appears to contain a small nucleus. These dilatations appear at first like little spots of the cuticle, and the latter consequently appears, under a sufficient magnifying-power, to be punctate.

The dorsal surface of the body is even. On the other hand, its ventral surface has some small appendages, of a conical form, whose position and number are always the same: all show the same conformation; they are cones formed by a prolongation of the cuticle, and enclosing an axial cord, which can be easily traced to the parenchyma of the body. This cord is separated from its cuticular covering by a liquid or semiliquid stratum. We find first of all six of these conical appendages disposed in a half-ring a little behind the buccal extremity; the two outermost are the largest, and the two innermost the smallest; the two intermediate ones have a medium size.

The following appendages are distributed in pairs on the two sides of the body, but in such a manner that the first two-fifths of its length are destitute of them. Between the two hindermost appendages are placed eight others of smaller size, in a transverse line. Lastly, there are two more placed near the generative pore. In all the cones in the posterior part of the body the axis appears to me to be double.

All these appendages are moveable, and serve, no doubt, as tactile organs, perhaps also as levers facilitating locomotion. Those which form transverse ranges appear to be mutually dependent, and move together like a comb.

The cuticle also bears vibratile cilia, which appear to play the principal part in locomotion when the animal is free: these cilia are exclusively ventral; they form a band which extends from the foremost pair of conical appendages for almost two-fifths of the total length of the animal. At this point, which is exactly at the level of the union of the œsophagus and intestine, the ciliated band stops abruptly; behind there are no vibratile cilia. The *Hemidasyes*, therefore, properly speaking, are *Thoracotricha* rather than properly *Gastrotricha*.

The anterior extremity is separated from the rest of the body by a slight constriction at the level of the anterior pair of ventral appendages. This part may be designated by the name of *cephalic lobe*, although, leaving the mouth out of consideration, it presents nothing which could characterize a head. This lobe is covered with slender and stiff bristles, like the tactile bristles of the Mollusca, Annelides, and Turbellaria, and in particular those of the other Gastrotricha. The mouth is terminal, surrounded by a circular lip broken up into little obtuse papillæ and covered with vibratile cilia. It leads

into a cavity which may be regarded as the buccal cavity, and from this into a straight muscular œsophagus, which extends through the first two-fifths of the body. This part of the digestive tube alone can enable us to understand the approximation that M. Ehlers has attempted to make between the Gastrotricha and the Nematoida. However, this analogy is of no importance. The cuticle of the œsophagus is a little thicker immediately behind the buccal cavity. The intestine is cylindrical and of a yellowish green colour, with its walls filled with granulations and little drops; it extends in a straight line to the anus. The rectum is colourless.

The nervous system is unknown in all the Gastrotricha hitherto investigated. In *Hemidasys agaso* this system seems also wanting, unless we may regard as of nervous nature four pairs of homogeneous and colourless globules lodged in the thickness of the parenchyma. Such an interpretation, however, would be very hypothetical. We might urge in its favour the fact that the first pair of these organs is in relation with a pair of little vibratile pits of the surface. These little organs remind us involuntarily of the vibratile pits of *Nemertes* and of many other Turbellaria, as well as of those of some Annelides—organs to which sensitive functions have often been ascribed. However, even in this case the functions of sensation are far from being demonstrated. The idea of an aquiferous or excretory system also naturally presented itself to my mind; but there was nothing to support this in my observations.

Hemidasys agaso is hermaphrodite. Originally I entertained a diametrically opposite opinion with regard to its sexual characters. In fact I had only found individuals with well-developed testes; but subsequently I found others loaded with their eggs, although otherwise formed like the first, and, in particular, furnished, like them, with a testis. If the individuals containing zoospermia but without eggs are frequent, on the other hand I have never met with individuals provided with eggs and destitute of zoospermia. This is how I explain this particular form of hermaphroditism:—Each individual only produces one egg, or rarely two at a time. After laying this egg, and before producing a new one, it loses temporarily all the characteristics of the female sex; nevertheless its male apparatus continues to possess zoospermia: hence an apparent predominance of the male sex.

The testis is an oval pouch, situated close to the intestine in the posterior part of the body. I have always found it filled with groups of zoospermia, fascicular bundles of the length of 0·044 millim.; their anterior third is undulated, the two other

thirds are simply filiform. Properly speaking, it would appear that we ought to regard this pouch as a seminal vesicle rather than as a testis; for I have only seen mature zoospermia in its interior. But I have found no other organ capable of being regarded as a male sexual gland. The deferent canal is always filled with zoospermia, and issues in a penis. This organ is formed by a vesicle full of a granular liquid, and by a spicule perforated by a canal along its axis. The point is directed towards the sexual pore, which is itself protected by two little plates. I have not been able to see ovaries, properly so called. An isolated egg in various stages of growth has alone met my eyes; sometimes there have been two of them. The mature ovule is oval, and its vitellus granular. The greater axis attains a length of 0·088 millim. The germinal vesicle ordinarily contains two spots. There is no special female pore; the sexual pore that I have described leads, in all probability, into an atrium common to both the male and the female apparatus.

The hermaphrodism of *Hemidasys agaso* deserves particular notice. M. Max Schultze had already thought that the Gastrotricha were hermaphrodite. This opinion has been combated in the most positive manner by M. Mecznikow. In all the other Gastrotricha the male elements have only been met with exceptionally; and M. Mecznikow supposed that the simultaneous presence of zoospermia and ovules noticed by M. Schultze was to be explained as occurring in fecundated females. In *Hemidasys agaso*, on the contrary, the presence of zoospermia is the rule, and its hermaphrodism is incontestable.

I conclude this article with a diagnosis of the genus:—

Genus Hemidasys.

Gastrotricha of a lineal form, with a vibratile coat restricted to the anterior region of the ventral surface. Body armed with a certain number of conical ventral appendages, which contain in the axis a prolongation of the parenchyma.

Species *Hemidasys agaso*, Clprd.

Inhabits the mud of the harbour of Naples, voluntarily fixing itself to the body of *Nereilepas caudata*, Delle Chiaje.

XXIV.—*Contributions to the Study of the Entomostraca.*

By George Stewardson Brady, C.M.Z.S. &c.

No. III. *Marine Ostracoda from Tenedos.*

[Plates XIV. & XV.]

In this gathering, for which I am indebted to my friend Mr. Thomas Blain, of Sunderland, the chief point of interest is the occurrence of two British species, *Cythere antiquata* (Baird), and *Pontocypris* (?) *angusta*, Brady. The shells of the second are empty, and I am not yet able to state with certainty whether the generic position assigned to it is correct. The first-named occurs abundantly, and is very finely developed; I have noticed it also in other collections from the shores of the Levant and Grecian Archipelago. The prevailing species in the gathering are *Cythere tarentina*, Baird, *C. Speyeri*, Brady, *C. favoides*, Brady, and *Loxoconcha affinis*, Brady.

List of Species.

Cypridæ.

?Aglaia pulchella, *Brady.*
Pontocypris (?) angusta, *Brady.*
—— intermedia, *nov. sp.*
Bairdia formosa, *nov. sp.*

Cytheridæ.

Cythere favoides, *nov. sp.*
—— Speyeri, *nov. sp.*
—— tarentina, *Baird.*
—— crispata, *nov. sp.*
—— dissimilis, *nov. sp.*
Cythere prava (*Baird*).
—— fistulosa (*Baird*)
(?= runcinata, *Baird*).
—— senticosa, *Baird*
(= hystrix, *Reuss*).
—— antiquata (*Baird*).
Loxoconcha affinis, *Brady* *.
—— alata, *nov. sp.*
Xestoleberis margaritea, *Brady*†.
Cytherura acris, *nov. sp.*
Sclerochilus (?) ægæus, *nov. sp.*
Paradoxostoma (?) reniforme, *nov. sp.*

Pontocypris intermedia, nov. sp. (Plate XIV. figs. 1, 2.)

Shell, viewed from the side, subtriangular; greatest height a little in front of the middle, and equal to half the length: anterior extremity broad and well rounded, posterior narrowed, almost angulated: superior margin forming an obtuse angle a little in front of the middle, thence sloping with a gentle curve to the front, but much more steeply backward; inferior margin scarcely sinuated. Outline, seen from above, ovate, with pointed extremities; greatest width situated in front of the middle, much less than the height. Colour white; surface smooth, granular. Length $\frac{1}{37}$ inch.

This presents characters intermediate between those of the

* *Normannia affinis*, Brady, Trans. Zool. Soc. vol. v. p. 382.
† *Cytheridea margaritea*, Brady, *ibid.* p. 370.

two common northern species, *P. trigonella* and *P. mytiloides*, but cannot, I think, be properly referred to either of them.

Bairdia formosa, nov. sp. (Plate XIV. figs. 5–7.)

Carapace, as seen from the side, subtriangular, highest in the middle; height equal to considerably more than half the length: anterior extremity rounded and bordered below the middle with several (usually from six to ten) unequal short spines; posterior produced below the middle into a short sharp beak, below which it bears a variable number of slender curved spines: superior margin very boldly arched, inferior almost straight. Seen from above, subrhomboidal, widest in the middle, more acutely pointed behind than in front; width equal to half the length. Surface of the shell closely and regularly impressed with small rounded punctures; colour white. Left valve much larger than the right, and overlapping on the dorsum. Length $\frac{1}{25}$ inch.

Cythere crispata, nov. sp. (Plate XIV. figs. 14, 15.)

Carapace, as seen from the side, compressed, oblong, subreniform; greatest height near the middle, and equal to rather more than half the length: anterior extremity obscurely rounded and crenulated below the middle, posterior truncate: superior margin gently arched, slightly excavated in front of the eyes; inferior almost straight: all the margins more or less rugged. Outline, as seen from above, oblong, subquadrangular, widest behind the middle, broadly mucronate in front, truncate behind, deeply constricted at the anterior third, and more gently near the middle; width considerably less than half the height. Surface of the valves exceedingly irregular, marked with waved, rounded, and irregularly flexuous ridges. Colour yellowish brown. Length $\frac{1}{43}$ inch.

This so much resembles, in outline and in style of surface-marking, *Cythere badia*, Norman, that in my 'Monograph of the Recent British Ostracoda,' I have, in the note on distribution, referred it to that species. A reexamination of the specimens, however, has induced me to believe that it ought to be considered distinct, though it must be admitted that the differences are chiefly of degree rather than of kind, consisting in the larger size and the excessive development of the rugosities of the surface. There is, however, a good distinctive character in the truncate posterior extremity. It seems to constitute a link between *C. badia* and a form previously (Trans. Zool. Soc. vol. v.) referred by me to *Cythere canaliculata*, Reuss.

Cythere favoides, nov. sp. (Plate XV. figs. 5–7.)

Carapace of the *female*, as seen from the side, subquadrangular, higher in front than behind; greatest height equal to rather more than half the length: anterior extremity well rounded and slightly dentate below the middle; posterior produced below the middle into a subsquamous flange or bordering process, slightly emarginate above the middle: superior margin a little elevated over the eyes, thence sloping gently backwards in an almost straight line; inferior gently sinuated. Seen from above, ovate, widest behind the middle; extremities obtusely mucronate; greatest width equal to half the length. Shell of the *male* much more elongated, the dorsal margin slightly sinuated; posterior extremity not so deeply excavated above the middle. Surface of the valves marked with a beautiful hexagonally reticulated pattern of delicate raised ridges, and towards the anterior extremity with a broad border, which is crossed by numerous radiating hair-like lines. Length of female $\frac{1}{24}$ inch.

Cythere Speyeri, nov. sp. (Plate XV. figs. 8–11.)

Shell of the *female* tumid. Seen from the side, broadly subreniform, highest in the middle; greatest height equal to nearly two-thirds of the length: anterior extremity rounded, posterior produced into a sort of beak below the middle, and excavated above: superior margin boldly arched, highest in the middle; inferior slightly sinuated in front of the middle, bending upwards behind. Seen from above, ovate, widest in the middle, broadly mucronate behind, obtusely pointed in front. Shell of the *male* (?) larger (fig. 8), the dorsal margin less conspicuously arched, the posterior not so prominently beaked. Surface of the valves marked with close and coarsely impressed round puncta; the ventral margin (of each valve) bearing towards the posterior extremity a single, sharp, downward-pointing spine. Length of female $\frac{1}{30}$ inch.

This species is very similar in general appearance to the British *C. convexa*, and differs chiefly in being very much more tumid: the peculiar ventral spine is also sometimes present in the British species.

Cythere dissimilis, nov. sp. (Plate XV. figs. 12 & 13.)

Valves, as seen from the side, subquadrate, highest in front of the middle; greatest height equal to rather more than half the length: anterior extremity broadly and somewhat obliquely rounded, posterior oblique, deeply excavated, and

terminating below in a strong triangular projection: superior margin gibbous over the anterior hinge, then deeply excavated, and terminating behind in a strong spinous elevation; inferior straight. Seen from above, the outline is hexagonal, deeply constricted in the middle, extremities mucronate. Shell-surface covered with closely set angular pittings, having an elevated ridge just within and parallel to the anterior margin, and two short and sharp longitudinal ribs on the central portion of the valve; one large triangular spine at the postero-superior angle, with two or three smaller ones below. Length $\frac{1}{52}$ inch.

Loxoconcha alata, nov. sp. (Plate XIV. figs. 8–13.)

Carapace of the *female*, as seen from the side, flexuous, subrhomboidal; greatest height near the middle, and about equal to two-thirds of the length; extremities obliquely rounded, the posterior slightly emarginate above the middle: superior margin gently arched, highest in the middle; inferior sinuated in the middle. Seen from above, the outline is rhomboidal, acutely pointed in front, mucronate behind, slightly constricted in the middle, behind which the lateral alæ form two conspicuous protuberances ending abruptly behind; greatest width behind the middle, nearly equal to the height. The shell of the *male* is more elongated, nearly equal in height throughout, the dorsal margin straight and abruptly angular at its posterior extremity. Surface of the shell marked with fine, closely set, subconcentrically arranged pittings, and having below the middle of each valve a subangular alæform projection. Length $\frac{1}{48}$ inch.

The nearest ally of this species is probably *Cytheropteron multiforum* (Norman). It is, perhaps, questionable whether *C. multiforum* ought not to be referred to the genus *Loxoconcha*; and had I, at the time of writing my monograph of the British species, been acquainted with the form now under notice, I should probably have taken that view of the matter. But, not having seen the animal of *C. multiforum*, having, moreover, seen no *female* carapaces recognizable as such (which in the present species have all the normal characters of the genus), and knowing of no instance of a distinct lateral ala in *Loxoconcha*, I was induced to consider it a *Cytheropteron*. It will be interesting, when opportunity occurs, to examine the animal of *C. multiforum*: if it be a true *Loxoconcha*, we must expect some day to find the hitherto overlooked females; if not, the present species would appear to form a curious connecting link between the two genera.

Cytherura acris, nov. sp. (Plate XV. figs. 3–4.)

Carapace of the (*male*?), as seen from the side, oblong, subclavate, nearly equal in height throughout; height scarcely equal to half the length: anterior extremity rounded, posterior produced in the middle into a long tapering process: superior margin nearly straight; inferior also straight or very slightly sinuated, produced posteriorly into a sharp spine. Seen from above, subhexagonal, oblong, with parallel sides, obtuse in front, sharply mucronate behind; width equal to the height. Valves obscurely reticulated, marked with two subparallel longitudinal ridges, the lower of which terminates behind, on the ventral surface, in a sharp spine, and thence runs rectangularly across the valve, forming a sharply cut declivity. Length $\frac{1}{30}$ inch.

The gathering contains also several specimens smaller and more tumid than those here described, which are probably the female of the same species.

Sclerochilus (?) *ægæus*, nov. sp. (Plate XIV. figs. 3, 4.)

Carapace, seen from the side, elongate, siliquose, highest in the middle; greatest height equal to less than half the length; extremities narrowly rounded, the posterior almost angular: superior margin boldly arched, sloping almost in a straight line to the front, but with a more distinct curve backwards; inferior sinuated in front of the middle, curving upwards behind. Outline, as seen from above, ovate, widest in the middle, extremities equally and subacutely pointed; width equal to fully one-third of the length. Surface smooth, white, with clouded patches. Length $\frac{1}{36}$ inch.

Paradoxostoma (?) *reniforme*, nov. sp. (Plate XV. figs. 1, 2.)

Carapace, seen from the side, elongate, reniform, nearly equal in height throughout; height much less than one-half the length; extremities evenly rounded: superior margin gently arcuate, inferior sinuated in the middle. Seen from above, compressed, ovate, acutely pointed in front, subacutely behind; width equal to scarcely one-third of the length. Surface smooth; colour whitish, marked with spots of white opacity. Length $\frac{1}{48}$ inch.

EXPLANATION OF THE PLATES.

Plate XIV.

Fig. 1. *Pontocypris intermedia*, seen from left side.
Fig. 2. The same, seen from above.
Fig. 3. *Sclerochilus* (?) *ægæus*, seen from left side.
Fig. 4. The same, seen from above.

Fig. 5. *Bairdia formosa*, seen from left side.
Fig. 6. The same, seen from above.
Fig. 7. The same, seen from the front.
Fig. 8. *Loxoconcha alata* (male), seen from left side.
Fig. 9. The same, seen from above.
Fig. 10. The same, seen from below.
Fig. 11. The same, seen from the front.
Fig. 12. The same (female), seen from left side.
Fig. 13. The same, seen from below.
Fig. 14. *Cythere crispata*, seen from left side.
Fig. 15. The same, seen from above.

PLATE XV.

Fig. 1. *Paradoxostoma* (?) *reniforme*, seen from left side.
Fig. 2. The same, seen from above.
Fig. 3. *Cytherura acris* (male?), seen from left side.
Fig. 4. The same, seen from above.
Fig. 5. *Cythere favoides* (male), seen from left side.
Fig. 6. The same (female), seen from left side.
Fig. 7. The same, seen from above.
Fig. 8. *Cythere Speyeri* (male), seen from left side.
Fig. 9. The same (female), seen from left side.
Fig. 10. The same, seen from below.
Fig. 11. The same, seen from the front.
Fig. 12. *Cythere dissimilis*, right valve, seen from the side.
Fig. 13. The same, seen from above.

[All magnified 40 diameters.]

XXV.—*Observations on the Classification of Echinida, to serve as an Introduction to the Description of the Tertiary Fossil Echinodermata of Western Algeria.* By A. POMEL*.

I HAVE had the honour to present to the Academy a series of lithographic drawings representing some fossil Echinodermata from Algeria, which are to form a part of the palæontology of that country. The descriptive part of the work is not yet printed; and I now submit to the judgment of the Academy the introduction to this work, in which I propose certain modifications in the classification followed by authors.

The number of the series of coronal plates, sometimes twenty, or two in each area, in the true Echinida, sometimes much greater by their multiplication in the interambulacral areas, and even in the ambulacral areas in the Tessellata, gives a first division, of the rank of a suborder.

The Echinida present three types, which advance regularly from the bilateral to the radial symmetry, and which I name *Spatiformes*, *Lampadiformes*, and *Globiformes*. The first have the mouth placed very eccentrically in front, and the anus behind; the obliteration of the anterior ambulacrum

* Translated from the 'Comptes Rendus,' Aug. 3, 1868, pp. 302–305.

and the obovate form mask the radial symmetry for the benefit of the bilateral. The second have the mouth central or nearly so, the ambulacra similar, and the anus more or less posterior, but often mounting high enough to enter into the series of the genital pieces, which open behind to receive it. The third have the mouth central and the anus opposite, always completely enclosed by the genital apparatus. This division appears to us more natural than the division into two groups of regular and irregular forms, the distinctive character of which is not so absolute as it has been represented.

The Spatiformes or *Spatangoïdes* form two groups, according as their ambulacra are constituted by simple pores throughout their whole extent (*Ananchytida*), or as these ambulacra are petaloid (*Spatangi*). The homogeneity of the family of true *Spatangi* is such that no one has yet supposed that it could be subdivided; however, an attentive study permits us to recognize and even to define in it several new well-marked groups.

1. The *Eupatagia* have the madreporic tubercle prolonged behind between the ocellar pieces in the place of the unpaired genital plate; their petals are even with the test, and provided on the interporiferous area with tubercles like those of the other areas; we may further separate in it the type with an internal fasciole (*Breynia*), that with lanceolate petals (*Eupatagus*), and that with sublinear petals (*Trachyspatagus*).

2. The *Brissia* are like the foregoing, as far as the madreporide goes; but their petals are depressed, well-defined, and with an interporiferous zone provided only with granules. Some have the tubercles of the back heterogeneous (*Leskia*); others have them almost homogeneous, and their periprocta is remarkably open (*Brissus*); others have some small, oblique, closely approximated dorsal tubercles and a moderate periprocta (*Brissopsis*).

3. The *Micrasteria* have the apical apparatus compact—that is to say, with the madreporic tubercle in the centre of the genital plates, which are contiguous. The tubercles of the back are most frequently scattered amidst an abundant granulation. The ambulacra are depressed and well defined. Almost all the genera have fascioles.

4. The *Toxasteria* have the apex compact, and some scattered dorsal tubercles; but their petals are even with the test, and the anterior ambulacrum has linear pores, either alone or mingled with round pores. The peristome is not so boldly labiated as in the other Spatangoïdes. There are no fascioles.

5. The *Holasteria* have the apex lengthened in consequence of the intercalation of the ocellar pieces between the genital pieces. The petals are still even with the test, with the pores but slightly developed in most of them. Some fascioles may be seen at the ambitus. In some the apex is continuous (*Holaster*); in others it is disjointed, and there are, as it were, two ambulacral summits (the sole genus is *Metaporinus*).

The *Ananchytida* are divided into two groups: the first, with the apex elongated, *Offaster*; the second, with the apex compact, *Stenonia*.

The *Lampadiformes* are either edentate or furnished with teeth. The former are divided into the *Echinoneida*, with a mouth without tubercle, or floscule, and with simple or subpetaloid ambulacra; and *Cassidulida*, furnished with a floscule and tubercle at the mouth, and with petaloid ambulacra. The second are divided into the *Clypeastroïda*, with petaloid ambulacra, and the *Echinoconida*, with simple ambulacra.

The *Echinoneida* comprise three types:—

1. The *Dysasteria* are still almost spatiform, and many authors have united them with the Ananchytida; but they have the ambulacra of the Lampadiformes on the inferior surface; their ambulacral summit is disjointed in the true *Dysaster*, and simply elongated in *Hyboclypus*.

2. The *Echinonea* have the ambulacra simple and uniform from the mouth to the apex, which is compact; the peristome is often oblique; of fossil genera *Pyrina* may be cited.

3. The *Caratomia* also have their apex compact, but their ambulacra pass into the petaloid form; they are almost simple in *Caratomis*, subpetaloid and unequal in *Asterostoma*, and petaloid in *Pygaulus*.

The *Cassidulida* are those of authors, less the *Caratomia*. Some have a very rudimentary floscule between the cushions, and the petals are dissimilar in *Archiaria*, similar in *Clypeus*; others have a well-developed floscule, with conjugated pores in *Pygurus*, non-conjugated pores in *Echinanthus*; and a fifth phyllodean type is remarkable on account of the shortness of the petals, *Faujasia*, foreshadowing the following type.

The *Clypeastroida* remain, divided into *Clypeastres*, *Scutellæ*, and *Laganæ*. However, it would be perhaps convenient to divide the last-mentioned group into true *Laganæ*, with a buccal rosette and petaloid ambulacra, and *Echinocyami* without buccal rosette, and with ambulacra hardly petaloid, and formed of non-conjugate pores.

The *Echinoconida* are, again, those of authors, less the tooth-

less types. Some have the anus far from the apex; the peristome is small and but slightly angular in *Echinoconus*; it is large and strongly notched in *Pygaster*; others have the frame of the periprocta partly constituted by the genital circle—*Echinoclypus*; and as the peristome is strongly notched, there is a manifest passage to the type of the regular Echinida.

The Globiform Echinida are very homogeneous, but yet they can be divided into two distinct subfamilies, the *Cidarida*, with the ambulacra prolonged on the buccal membrane, and destitute of buccal branchiæ, and the *Echinida*, with the ambulacra not prolonged, but provided with buccal branchiæ, applied against the frame of the peristome in a more or less deep notch.

The *Cidarides* are only varied in a slight degree; some have the ambulacra flexuous—*Temnocidaris* and *Cidaris*. Others have the ambulacra straight, and the tubercles relatively small—*Orthocidaris* and *Diplocidaris*.

The *Echinides* are, of all the Echinida, those in which the serial arrangement is most difficult to find. We have decided to make two groups of them, the perforation of the mamilla of the tubercles being characteristic of the *Diademia* and wanting in the *Echinia*.

The *Salenia* have been raised into a tribe, and even into a family, because one of the pieces which, in the ordinary Echinida invest the anal membrane, is in this case fixed to the test, and also because the anus is eccentric in the periproctal frame, as is the case in many other living types. It is therefore probable that this tribe will be suppressed, or perhaps be distributed among the others.

The *Diademia* include several types; *Heterocidaris*, with short ambulacral lips and a small peristome; *Hemicidaris*, with a large, diagonal peristome, and with very narrow ambulacra; *Diadema* differing from these by its tubercles being equal in the two areas; and *Pedina* with a small peristome, much notched, and with slightly developed tubercles.

The *Echinia* are a little more varied; the peristome has its lips but slightly unequal, and its notches sharp in some; the test has no sculpture, and the tubercles of the two areas are unequal in *Æropeltis*, subequal in *Phymasoma* and *Cœlopleurus*; the test is ornamented with sculpture and impressions in *Temnopleurus* and *Salmacis*. The peristome has no notches, or very slight ones, and the lips are very unequal in *Codechinus*, equal in *Psammechinus*. Its notches are very clean, and even deep, and the lips very unequal, in *Magnosia* and *Stomechinus*. The peristome is almost round, and the notches are narrow and deep in *Tripneustes*. Lastly, with

the peristome of *Phymasoma* we have the ambulacra almost petaloid at the base in *Heliocidaris* and *Acrocladia*.

It may be remarked that the above classification arranges the Echinida in two continuous series, namely, the *toothless* and *toothed*; all that was necessary to obtain this incontestable improvement was to refer the *Echinonea* to their proper place.

MISCELLANEOUS.

On a Collection of Pteropods and Heteropods.

By F. P. Marrat.

The following collection of Pteropods and Heteropods was obtained by Capt. Whiteway, of the ship 'Annie Cheshyre,' during several voyages from Liverpool to Valparaiso. This gentleman has been in the habit of collecting various marine objects, and with the utmost liberality has given them to our local museums and private collectors. It is truly surprising to find what a very large number of interesting specimens have been procured by the indefatigable exertions of a single individual. The following list comprises only one section of his work. The specimens were placed in my hands, and were found to include the following species:—

Pteropoda.

Cavolina tridentata, *Forsk.*
—— Forskalii, *D'Orb.* (?)
—— gibbosa, *Rang.*
—— uncinata, *Rang.*
—— limbata, *D'Orb.*
—— longirostris, *Lesueur.*
—— quadridentata, *Lesueur.*
—— labiata, *D'Orb.*
—— depressa, *D'Orb.*
Diacria mucronata, *Quoy & Gaim.*
—— trispinosa, *Lesueur.*
Clio cuspidata, *Bosc.*
Clio lanceolata, *Lesueur.*
—— pyramidata, *Browne.*
Balantium recurvum, *Children.*
Styliola recta, *Lesueur.*
—— corniformis, *D'Orb.*
—— subulata, *Quoy & Gaim.*
—— virgula, *Rang.*
Triptera columnella, *Rang.*
Spirialis rostralis, *Eyd. & Soul.*
—— inflata, *D'Orb.*
—— rotunda, *D'Orb.*
Heterofusus bulimoides, *D'Orb.*

Heteropoda.

Ianthina bifida, *Nuttall.*
—— communis, *Lam.*
—— globosa, *Swain.*
—— exigua, *Lam.*
—— fragilis, *Lam.*
Atlanta brunnea, *Eyd.*
—— inclinata, *Eyd.*
—— Peronii, *Lesu. & Blainv.*
Atlanta rosea, *Eyd.*
—— involuta, *Eyd.*
—— Lesueurii, *Eyd.*
—— inflata, *Eyd.*
—— turricula, *D'Orb.*
Oxygyrus Keraudrenii, *Rang.*
Carinaria cymbium, *Linn.*

2 Peveril Terrace, Edge Lane, Liverpool.
August 12, 1868.

Observations on some Mammalia from the North of China.
By M. A. Milne-Edwards.

Carnivora.—The author indicates two species of the genus *Meles*, *M. leptorhynchus* and *M. leucolæmus*. The former resembles the common badger in appearance; but the black bands on the sides of the head are much diminished and narrow, so as not to pass the ear beneath. The cranium is much more narrowed between the orbits, and the whole fronto-nasal region is very narrow. The anterior aperture of the nostrils is small, the lower margin of the posterior nares is much more produced, and the lateral margins of the adjacent portion of the palatine arch constitute each a trenchant crest passing outside the outer face of the ala of the pterygoid. The upper tubercular molar is narrower and more elongate than in the European badger.

M. leucolæmus differs considerably from the known representatives of the genus, and might be regarded as the type of a new generic group. It is much smaller than the preceding (which is somewhat less than *M. taxus*); its hairs are much longer, and its throat and breast pure white. The skull is much shortened, especially in its cranial portion, the crests of which are scarcely salient. The part immediately behind the postorbital angles is not narrowed. The anterior frontal region is broad and depressed, whilst the muzzle is much drawn out, giving the face a conical form. The suborbital foramen is enormous, and the zygomatic arches very short. The exterior meatus auditorius is remarkably large, and approximated to the glenoid cavity. The mastoid apophyses are scarcely prominent. The tympanic cases, instead of being much inflated, are extremely depressed. The aperture of the posterior nares is thrown very far back, beyond the level of the articulation of the lower jaw. The third superior incisor is very oblique, and extends nearly to the canine; it is deeply worn by the friction of the lower canine. The tubercular molar is comparatively little developed. Both these species inhabit the vicinity of Pekin.

Panthers are common in this part of China; and, according to M. Fontanier, two species occur there. Of one of these the fur is much longer and thicker than in the Indian leopard, and the tail is very thick from base to apex; the skull is much more arched from before backwards than in the Indian and African leopards, the cranium is more developed, and the fronto-nasal region longer; the posterior margin of the bony palate is strongly emarginate, and the aperture of the posterior nares is short and broad. The skull differs considerably from that of Gray's *Leopardus chinensis*; and the species is named by the author *Felis Fontanierii*.

Rodentia.—Two large species of *Pteromys* inhabit the forests of the Tscheli Mountains. The largest, *P. melanopterus*, is nearly of the size of *P. momoga* from Japan, from which it is distinguished by the much greater length of the tail, and by the slightly fulvous-grey colour of the upper part of the body, which contrasts with the nearly black tint of the upper surface of the parachutes and feet. The

other, *P. xanthipes*, is rather smaller, and has a short but very thickly furred tail. It is yellowish grey above, becoming fulvous on the lateral membranes and feet. The body beneath is greyish.

Ruminants.—M. Fontanier brought from Pekin a stag equal to *C. elaphus* in stature, and resembling that species in its general characters. It is distinguished by the more elongate form of the head, the greyer colour of the coat, and by the great development of the ischiatic patch, which is yellow. Hence the author names this species *Cervus xanthopygus.*—*Ann. Sci. Nat.* sér. 5. tome viii. pp. 374–376.

Notes on some Algæ from a Californian Hot Spring. By Dr. H. C. Wood, Jun., Professor of Botany in the University of Pennsylvania.

Some time since, Prof. Leidy handed me for examination a number of dried Algæ, which he had received from Prof. Seidensticker, by whose sister, Mrs. Partz, they had been gathered in the "Benton Spring," which is situated in the extreme northern point of Owen's Valley, California, sixty miles south-west from the town of Aurora. Afterwards a number of similar specimens came to me directly from Mrs. Partz by mail. The subject of life in thermal springs is one of so much general interest, especially in connexion with that of spontaneous generation, as to induce me to make a very careful examination of the material and offer the results to the readers of this journal. In this connexion the following extract from a letter of Mrs. Partz to her brother is very relevant:—

"I send you a few samples of the singular vegetation developed in the hot springs of our valley. These springs rise from the earth in an area of about 80 square feet, which forms a basin or pond that pours its hot waters into a narrow creek. In the basin are produced the first forms, partly at a temperature of 124°–135° F. Gradually in the creek and to a distance of 100 yards from the springs are developed, at a temperature of 110°–120° F., the Algæ, some growing to a length of over 2 feet, and looking like bunches of waving hair of the most beautiful green. Below 100° F. these plants cease to grow, and give way to a slimy fungus growth, though likewise of a beautiful green, which, finally, as the temperature of the water decreases, also disappears. They are very difficult to preserve, being of so soft and pulpy a nature as not to bear the least handling, and must be carried in their native hot water to the house, very few at a time, and floated upon paper. After being taken from the water and allowed to cool, they become a black pulpy mass. But more strange than the vegetable are the animal organizations, whose germs, probably through modifications of successive generations, have finally become indigenous to these strange precincts. Mr. Partz and myself saw in the clear water of the basin a very sprightly spider-like creature running nimbly over the ground, where the water was 124° F., and on another occasion dipped out two tiny red worms."

In regard to the temperatures given, and the observation as to

the presence of animal life in the thermal waters. Mr. Wm. Gabb, of the State Geological Survey, states that he has visited the locality, knows Mrs. Partz very well, and that whatever she says may be relied on as accurate.

The colour of the dried specimen varies from a very elegant bluish green to a dirty greenish and fuscous brown. After somewhat prolonged soaking in hot water, the specimens regained apparently their original form and dimensions, and were found to be in very good condition for microscopical study.

The plant in its earliest stages appears to consist simply of cylindrical filaments, which are so small that they are resolved with some difficulty into their component cells by a first-class one-fifth objective. Fronds composed entirely of filaments of this description were received. Some of these were marked as "first forms," and as having grown in water at a temperature of 160° F. Probably these were collected immediately over the spot where the heated water bubbled up. At this temperature, if the collection made is to be relied on as the means of judging, the plant does not perfect itself. To the naked eye these "first forms" were simply membranous expansions, of a vivid green colour and indefinite size and shape, scarcely as thick as writing-paper, with their edges very deeply cut and running out into a long waving hair-like fringe. Other specimens, which grew at a much lower temperature, exactly simulated those just described, both in general appearance and microscopical characters.

These, I believe, were the immature plant.

The matured fronds, as obtained by the method of soaking above described, were "gelatinous membranous," of a dirty greenish or fuscous brown at their bases, and bright green at their marginal portions, where they were deeply incised and finally split up into innumerable hair-like processes. Proximally they were one or even two lines in thickness, distally they were scarcely as thick as tissue paper. Their bases were especially gelatinous, sometimes somewhat translucent, and under the microscope were found to have in them only a few distant filaments.

Two sets of filaments were very readily distinguished in the adult plant. The most abundant of these, and that especially found in the distal portions of the fronds, were composed of uniform cylindrical cells, often enclosed in a gelatinous sheath. The diameter of such filaments varies greatly; in the larger the sheaths are generally apparent, in the smaller they are frequently indistinguishable.

In certain places these filaments run more or less parallel side by side, and are glued together into a sort of membrane. It is only in these cylindrical filaments that I have been able to detect heterocysts, which are not very different from the other cells: they are about one-third or one-half broader, and are not vesicular, but have contents similar to those of the other cells. In one instance only was I able to detect hairs upon these heterocysts.

The larger filaments are found especially near the base and in the other older portions of the frond. Their cells are generally irregu-

larly elliptical or globose, rarely are they cylindrical. They are mostly of an orange-brown colour; and there exists a particular gelatinous coating to each cell rather than a common gelatinous sheath to the filament. These larger threads are apparently produced from the smaller filaments by a process of growth.

Near the base and in the under portions of the fronds, these filaments are scattered in the homogeneous jelly, in which they run infinitely diverse courses. In the upper portions of the frond, and at some little distance from the base, the adjoining cells are very close to one another, and pursue more or less parallel courses, with enough firm jelly between to unite them into a sort of membrane.

This plant certainly belongs to the Nostochaceæ, and seems a sort of connecting link between the genera *Hormosiphon* of Kützing and *Nostoc*.

The best algologists now refuse to recognize the former group as generically distinct; and the characters presented by this plant seem to corroborate that view.

The species appears to be an undescribed one; and I would propose for it the specific name *Caladarium*, which is suggested by its place of growth. There are several species of allied genera, which grow in the hot springs of Europe; but no true *Nostoc* has, I believe, been found before in thermal waters. The following is the technical description of the species;—

N. caladarium, sp. nov.

N. thallo maximo, indefinite expanso, aut membranaceo-coriaceo vel membranaceo-gelatinoso vel membranaceo, aut læte viridi vel sordide olivaceo-viridi vel olivaceo-brunneo, irregulariter profunde laciniato-sinuato, ultimo eleganter laciniato; trichomatibus inæqualibus, interdum flexuoso-curvatis, plerumque subrectis et arete conjunctis, in formis duabus occurrentibus: forma altera parva, viridis, articulis cylindricis, cum cellulis perdurantibus hic illic interjectis, vaginis interdum obsoletis, sæpius diffluentibus, instructa; forma altera maxima, articulis globosis vel oblongis, aurantiaco-brunneis, cellulis perdurantibus ab ceteris haud diversis.

Diam. Cellulæ cylindricæ maximæ $\frac{1}{10000}$ unc.; cellulæ perdurantis $\frac{1}{8000}$ unc.

Diam. Formæ primæ articuli maximi $\frac{1}{10000}$ unc.; cellulæ perdurantis $\frac{1}{8000}$ unc. Formæ secundæ articuli oblongi longi $\frac{1}{2000}$–$\frac{1}{3000}$ unc., lati $\frac{1}{5000}$–$\frac{1}{6500}$, articuli globosi $\frac{1}{3500}$–$\frac{1}{4000}$ unc.

Adherent to, and often more or less imbedded in, the fronds of the Nostoc, were scattered frustules of several species of diatoms, none of which was I able to identify. In some of the fronds there were numerous unicellular Algæ, all of them representatives of a single species belonging to the genus *Chroococcus*, Nägeli. This genus contains the very lowest known organisms—simple cells without nuclei, multiplying, as far as known, only by cell-division. These cells are found single or associated in small families; and in certain species these families are united to form a sort of indeterminate gelatinous

stratum. In this species the families are composed of but very few cells, surrounded by a very large, more or less globular or elliptical mass of transparent firm jelly. The species is very closely allied to *Chroococcus turgidus*, var. *thermalis*, Rabenh., from which it differs in the outer jelly not being lamellated.

The following is the technical description of the species :—

C. thermophilus, sp. nov.

Ch. cellulis singulis aut geminis vel quadrigeminis et in familias consociatis, oblongis vel subglobosis, interdum angulosis, haud stratum mucosum formantibus; tegumento crassissimo, achroo, haud lamelloso, homogeneo; cytioplasmate viridi, interdum subtiliter granulato, interdum homogeneo.

Diam. Cellulæ singulæ sine tegumento longitudo maxima $\frac{1}{1500}''$, latitudo maxima $\frac{1}{2300}''$.—*Silliman's Journal*, July 1868.

Description of two Sacculinidæ. By M. Hesse.

The author remarks upon the importance of the habitat of parasitic Crustacea in ascertaining their identity, and states that, with but few exceptions, these animals are strictly confined to particular species of Crustacea or fishes. He describes two new species of *Sacculinidæ* parasitic upon crabs.

Sacculinidia Gibbsii.

Larger than the examples found on *Carcinus mœnas*, being 25 millims. in length, 20 in breadth, and 10 in thickness. Its form is rounded quadrate, slightly flattened laterally; the pedicle, which is short, presents on each side two rounded protuberances, reverted towards the upper part of the body. The position of the *anal orifice* varies in consequence of the contractions of the body; it is generally placed directly opposite to the pedicle. Its construction is exactly as in the parasite of *Carcinus mœnas*.

The skin is thin, showing through it the meanders of the oviferous tubes. It has a velvet-like appearance, and is very tense. The *ova* are large, oval, and contain only a single vitellus. The *eye* appears as a red spot; at the middle of the body laterally are two round black spots, which always occupy the same place. The colour of the body is very deep yellow, with a reddish-brown tinge.

The specimen was found, in January 1867, on the abdomen of an example of *Pisa Gibbsii*, where it was not protected by the carapace. M. Hesse remarks that it is singular that the *Pisa* had not freed itself from its parasite, which it could easily reach.

Sacculinidia Herbstia nodosa (!).

Measurements, $25 \times 15 \times 5$ millims. Resembles the parasite of *C. mœnas* in form, but presents laterally two horizontal expansions, one forming a cylindrical process, the extremity of which is curved downwards like a hook. Anal aperture placed at the middle of the

lower part of the body. Pedicle long, and much dilated at base. Colour light yellow. Found, in November 1867, attached to the intestinal canal of *Herbstia nodosa*.

The author remarks that the Sacculinidous parasite of *C. mœnas*, after getting rid of its ova, has a very transparent envelope of a light bluish colour. Through this the body of the parasite is visible, shifted to the upper part of the envelope, close to the buccal orifice and pedicle; it is opaque, and of a yellow colour. After a time the parasite dies, shrivels, and becomes detached, when its former position is indicated only by a chitinous ring. From this, flat squamous corneous pieces are seen to radiate towards the centre: these have denticulated margins; they leave at the centre an oval orifice, establishing the communication between the parasite and its victim. These parts are probably moveable, and may, by rising or sinking, alter the size of the orifice. In course of time all these traces of the presence of the parasite become obliterated.—*Ann. Sci. Nat.* sér. 5. tome viii. pp. 377–381.

On the Calamites and Fossil Equiseta.
By M. Schimper.

M. Schimper has referred to the Equisetineæ of the Carboniferous, Triassic, and Jurassic periods, and has endeavoured to prove that the Calamites ought to have their place in that group of vascular Cryptogamia, not only because of the external and internal structure of the stem, but also because of their organs of fructification, which show a great analogy with those of the *Equiseta* of the present epoch. He has shown that the fossil spikes that were taken for spikes of Calamites, and which are remarkable for their great resemblance to the catkins of the Lycopodiaceæ, do not belong to the Calamites, but to *Annularia* and *Sphenophyllum*, fossil genera which establish the passage from the *Equiseta* to the Lycopodiaceæ.

M. Schimper has also proved, by means of some fine specimens and a number of drawings, that all the fossil trunks of the Bunter Sandstone, of the Keuper, and of the Rhætic strata, that had been designated under the names of Calamites, belong to thegenus *Equisetum*.

The trunks of these gigantic *Equiseta* had a diameter of more than 12 centimetres and a height of from 8 to 10 metres; the branches which adorned the higher parts of them, in the form of a crown, were simple, and bore at their extremity a spike of the size of a pigeon's egg and organized exactly like the spikes of our living *Equiseta*. The subterranean rhizomes were well developed, and gave origin, like those of many of our *Equiseta*, to tubercles which had the form and size of a hen's egg.

According to M. Schimper, *Equisetum columnare* (Brongn.), of the Oolite of Scarborough, is specifically different from the homonymous species of the Keuper.—*Société d'Hist. Nat. de Strasbourg*, Feb. 5, 1868; *Bibl. Univ.* Aug. 15, 1868. *Bull. Sci.* pp. 325–326.

On the Contractile Tissue of Sponges. By N. Lieberkühn.

In a recent supplement to his numerous investigations of Sponges, Lieberkühn has paid special attention to the ciliated embryos of the Spongillæ. The ova present a perfectly regular segmentation. They are situated, like the embryos, in lacunæ of the parenchyma of the body. It is there also that the spermatic cells are found. To observe the embryos, Lieberkühn divides the *Spongilla* into thin sections, which he leaves to soak in water for a day. The embryos up to the moment when they commence their independent life remain in the envelope formed by the contractile tissue of the sponge, in which they turn about by means of their ciliary coat. During this period the cavity of the body, which is filled with liquid, is formed. A portion of the spheres of segmentation which have not undergone much modification are crowded together in the posterior part of the body, where they form an opaque mass. The cilia of the embryo are very long, and implanted upon still amorphous sarcode, and not upon true cells. The mass of the embryo properly so called, however, is formed by contractile and nucleated cells, a portion of which enclose siliceous spicules in their interior. This tissue is identical with the contractile parenchyma of the sponge itself.—*Archiv für Anat. und Physiol.* 1867, p. 509; *Bibl. Univ.* 1868, *Bull. Sci.* p. 168.

Comparative Investigation of the Generative Organs of the Hare, Rabbit, and Leporide. By S. Arlong.

The author gives an account of the anatomy of the generative organs in the Leporides produced by the union of a male and female hybrid between a male hare and female rabbit.

In certain organs, such as the feet and the ovaries, the Leporide occupies a middle place between the hare and the rabbit. The generative organs are complete in both sexes. In the female the ovaries resemble those of the hare in colour and texture, and those of the rabbit in the volume and dissemination of the Graafian vesicles. The vagina and vulva, on the other hand, resemble those of the rabbit in their dimensions, the position of the meatus urinarius, and the extent and arrangement of the canal of Gaertner. The fecundity of these hybrids is shown by their anatomy: the females possess many ovules, and the testes of the males furnish a liquid filled with spermatozoids. In the mule, Brugnone is the only observer who has detected spermatozoids.

The author concludes with the following summary of results:—

1. The female hybrid of the hare and rabbit can be fecundated by the male hybrid.

2. These hybrids, whilst presenting intermediate characters, possess genital organs which much more resemble those of the rabbit than those of the hare.—*Comptes Rendus*, June 22, 1868, pp. 1267–1269.

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XXVI.—*On the Typical Value of the Lingual Dentition in the right Distribution of the Genera of Gasteropoda into Natural Groups and Families.* By JOHN DENIS MACDONALD, M.D., F.R.S., Staff Surgeon, R.N.

[Plate XVI.]

THOUGH many of the weak points of pure conchology have been brought to light by the study of the lingual dentition of the Gasteropoda, there is yet much more to be accomplished, embracing not only the acquisition of new facts by further research, but the right use of those already in our possession. We are, even now, only sufficiently acquainted with the subject to know that any system of conchology, however plausibly framed, cannot be reliable where this important test has not been brought to bear. It is nevertheless true that the import of the dental characters has been either misinterpreted or not sufficiently taken into account in some of our best works on malacology. It is scarcely to be believed, for example, that, as at present received, the greater number of the genera of the two significant families Muricidæ and Buccinidæ require reciprocal change of place, the truth of which position will be demonstrated as we proceed with the inquiry.

Mr. Jabez Hogg, in a paper* lately read before the Microscopical Society, quotes a passage from Mr. S. P. Woodward's 'Manual of Mollusca,' that I had already transcribed for my own purpose some eight or nine years ago; but, as that purpose does not appear to be infringed upon by the tenor of Mr. Hogg's reasoning, I shall still adopt the quotation in question, as affording a good idea of the commonly received views of classification by the lingual dentition (*op. cit.* p. 450):—

* "On the Lingual Membrane of Mollusca, and its value in Classification," by Jabez Hogg, F.L.S. &c., published in the 'Quarterly Journal of Microscopical Science,' No. 31, July 1868.

"The patterns or types of lingual dentition are on the whole remarkably constant, but their systematic value is not uniform. It must be remembered that the teeth are essentially epithelian cells, and, like other superficial organs, liable to be modified in accordance with the wants and habits of the creatures. The instruments with which animals obtain their food are of all others the most subject to those adaptive changes, and can never form the basis of a philosophical system." And I add here a note from the bottom of page 450 :—"The carnivorous opossums have teeth adapted for eating flesh, but are not on that account to be classed with placental carnivora."

To state that the *systematic value* of the types of lingual dentition is not uniform implies, first, that we are fully acquainted with a subject which is yet avowedly only in its infancy; and, secondly, that from this knowledge notable instances may be advanced demonstrating the truth of the assertion. We are surely not to form a hasty conclusion to this effect from the analysis of such a family as the Bullidæ, for example, including a mass of beings differing as much *inter se* as the families of Pteropoda, and much more than the three acknowledged families of Heteropoda do. Now the principle which I desire to maintain is that Gasteropoda whose general anatomical characters, including the configuration, sculpturing, and minute structure of their shells, suggest their distribution in the same group will be found still further to be associated as well as distinguished by the type and peculiarity of their lingual dentition—moreover, that *prima facie* resemblance or difference, with or without conformity in the dentition of the animals, may only require a little further investigation to reveal their natural affinities or antipathies. Anticipating myself a little, I think I may safely state, from extended observation, that *Concholepas*, *Purpura*, *Ricinula*, *Vitularia*, or any other genus properly referable to the Muricidæ will always be found with a lingual dentition unequivocally on the type of that of *Murex*. But if some *Pisaniæ*, *Ranella*, *Triton*, *Fasciolaria*, and other equally incongruous genera are associated with them, it is no wonder that the dentition should be found to exhibit no "uniform systematic value." For further illustration we may select the Buccinidæ, whose dental characters are so distinctive that any single genus properly belonging to it can never be confounded with Muricidæ or any other family. The excellent authorities Forbes and Hanley (vol. iii. p. 388), speaking of the genus *Nassa*, remark that "it is one of the best marked and most easily recognized groups, both as to shell and animal, among the Muricidæ (!), though some conchologists strangely persist

in mingling it with *Buccinum*." The buccinoid type of ribbon is nevertheless invariably found with *Nassa*, *Cyclonassa*, *Pusiostoma* (Sw.), *Myristica*, and numerous other genera strictly appertaining to the family. But if *Ricinula*, *Planaxis*, *Cassis*, *Columbella*, and *Oliva* are placed in the same category, the dental characters will assuredly be found wanting; for the genera just mentioned cannot, with any justice to zoological science, be distributed into less than five distinct families apart from Buccinidæ.

I conclude therefore that, until all the families of the Gasteropoda have been sifted in this way, superfluous families rejected and nature's own families found, we cannot be in a position to affirm that the dental characters are not in all cases to be depended upon—though this may be in reality quite true.

If it is intended, by the assertion that the "teeth are essentially epithelian cells," to lessen their morphological importance and convey the idea of mutability, surely we ought to be able to draw a distinction between the normal and abnormal development of the same organs in different members of the same species. Moreover the teeth are formed from a special matrix at the fundus of the lingual sac, determining in every case the constant evolution of certain characters; and any defect in the formative pulp will repeat any consequent malformation in each succeeding row of teeth.

If it is implied that, as it were, obedient to circumstances affecting adaptation, nature may possibly give a buccinoid ribbon to a veritable *Murex*, such a doctrine is quite untenable. My own impression is that the distinctive characters of the teeth are in accordance with a definite plan, whether we associate this with the adaptation of the creatures to the special conditions of their existence or not. Any one finding *Helicina* (a truly terrestrial Nerite) and *Helix* (an inoperculate bisexual snail, with a broad lingual pavement) feeding in a tropical forest under precisely similar circumstances, would be inclined to yield the palm to the plan rather than to the conditions of existence. On Mr. Darwin's beautiful hypothesis, the divergence of species from a primitive type may be readily admitted; yet, like the coloured components of white light diverging from the prism, it would be unphilosophical to suppose them capable of reciprocally interchanging their characters and properties, even if it were possible to refer all to a common source.

No one would approve of establishing the peculiarities of the dentition of Mammalia or of any other great class of animals as a kind of ready reckoner of affinities, without taking into

account all other important structural particulars. Using a similar mode of reasoning to that adopted by Mr. Woodward, it might be said that although the dentition and habits of the pteropods *Creseis* and *Hyalæa* are obviously carnivorous, they are not on this account to be classed with the whelks or any other carnivorous Gasteropoda; nor, indeed, should they. But for this I will contend, that the dental characters are of equal importance in the discrimination of the Opossum from the Bandicoot, *Clio* from *Pneumodermon*, and of *Murex* from *Buccinum*, and that the genuine gasteropodous families are to be distinguished by their teeth, subordinate to certain broader features of structure, including union or distinctness of the sexes.

The question as to the actual number of rows of teeth occurring in any particular genus or species ought not to supersede the consideration of other characters afforded by them; for it is just possible that the typical number forming part of the morphological plan of the family may be rendered obscure by suppression and modified development in minor types. I endeavoured on a former occasion to set forth this principle, and I have since found abundant proof of its correctness. Here, indeed, it may be assumed that there is a want of uniformity; but, as even this appears to be amenable to fixed laws, the defect is more likely to be in our own philosophy than in the institutions of nature. The dental formula of *Conus*, *Terebra*, and *Pleurotoma* may be assumed to be a *single series* of fangs in each pleura, with a naked central space, characterizing the Toxifera of Dr. Gray; yet when in *Clavatula* we find five rows of dental organs arranged as though the teeth of *Mitra* had been inserted between those of *Bela* or *Mangelia*, we recognize a primary and two minor types, depending upon the suppression of the central or the pleural teeth, as the case may be. Other examples of suppression of one or more of the members of the typical ribbon are to be found amongst the Turritellidæ and the Lamellariadæ. It is also of importance to observe the manner in which the dental processes are connected with the basal plates, and in particular whether they are recurved from the fore part of those plates or arise near or from their posterior border, in which latter case the teeth are not recurved, but point directly backwards. Thus the words *recurved* and *direct* would sufficiently express the two principal conditions here indicated, the dental points being in all cases retrorse. As a general rule, the teeth are recurved in the vegetable feeders, and direct in the carnivora. Simple fanged teeth, or those without foliations, are carnivorous, whether disposed in the manner of a

pavement, as in *Ianthina* or *Scalaria*, or in the pleuræ of a lingual ribbon, as in *Atlanta* and *Carinaria*. There are, however, mixed characters in the dentition of some genera; and the subject requires much careful study to elicit all that may be deducible from it as a guide to classification.

It would be very desirable to establish a fixed nomenclature for the parts, and some uniform mode of description of the lingual apparatus, so that the dental characters of any species referred to the fixed types shall be definite and unequivocal.

I have already employed Prof. Huxley's excellent name "odontophore" for the tooth-bearing membrane, with its expanded alæ in front embracing the tip of the tongue and being continuous with the lining membrane at the sides of the oral cavity, the posterior tubular portion of this organ, named the lingual sac, carrying the teeth upon its floor, extending backwards to the closed extremity containing the dental pulp or formative matrix, and forwards over the tip to the frænum of the tongue. The upper wall of the lingual sac terminates anteriorly in a crescentic fold, by which it becomes continuous with the lining of the œsophagus. The fore part and body of the tongue proper is supported by lateral cartilages wrapped together by muscle and ligament at the mesial line, and often having smaller supplementary pieces moveably articulated in front, as in the *Turbos* and *Nerites*. The cartilages in the carnivorous families in particular conjointly form a grooved surface, over which the odontophore glides when in action. The common dental area or the space occupied by the teeth is usually divided into three lesser longitudinal areas, a central and two lateral, commonly known as rachis and pleuræ. The latter name may be retained; but the "central dental area," though longer, is preferable to "rachis," which is not sufficiently definite.

The *central area* usually presents a median series of dental plates, either alone or with one or more lateral series. The median series, however, is often suppressed. The pleuræ may present one, two, three, or many longitudinal rows of teeth; and these are numbered, from within outwards, first, second, third, &c.

With what has been already said of the basal plates and dental processes connected with them, this brief anatomical sketch will answer all practical purposes. The special types of dentition will be noticed when the groups or families which they characterize come under consideration.

Having completed the foregoing introductory remarks, I

shall now attempt the grouping of all the genera which I have found (in many cases by repeated personal observation) referable either to Buccinidæ or Muricidæ, substantiating my position by satisfactory proof and reference to the labours of others, furnishing decisive evidence in authentic preparations, figures, and descriptions.

In order that there should be no possible mistake in the types of the two very distinct forms of dentition to which I refer, I have selected two examples for each, viz. those of *Buccinum undatum* (Pl. XVI. fig. 1, odontophore laid flat) and *Cassidulus melongena* (fig. 2) for Buccinidæ, and those of *Murex tenuispina* (fig. 3) and *Concholepas peruviana* (fig. 4) for Muricidæ.

Buccinidæ.

Lingual dentition triserial, the distinctive feature of which is a stout conical fang at the inner extremity of the pleural plates.

Systematic Name.	References and Remarks.
Buccinum undatum	Preparations and drawings, fig. 1.
—— cyaneum	Gray's 'Guide to Mollusca,' p. 22, referring also to Lovén, t. 5. f. 5.
Cantharus undosus	Personal observation in Fiji, and an excellent preparation in Mr. Barron's collection.
Pisania striata	Personal observation in the Mediterranean; description, Gray, *op. cit.* p. 13.
Pusiostoma mendicaria .	Personal observation and preparation.
Cominella maculosa, & two undetermined sp.	Figured by Hogg, *op. cit.* pl. 10. fig. 33; description, Gray, p. 16.
Chrysodomus antiquus	Forb. & Hanl. vol. iii. p. 427, fig. 31; Gray, fig. 9, p. 13; Mr. Barron's preparations.
—— propinquus	F. & H., description, vol. iii. p. 420.
—— islandicus.....	Ibid. p. 419, pl. SS. fig. 2 *c*; Mr. Barron's preparations.
—— gracilis	Figured by Hogg, plate 10. figs. 32 & 34.
Nassa reticulata	Description of dentition, Gray, p. 17, and Lovén's figures, t. 5.
—— annulata	
—— incrassata.....	
—— arcularia	
—— badia.....	Mr. Barron's preparations.
Neritula neritacea	Ditto.
Cassidulus melongena ..	Personal observation at Jamaica, preparations and drawings.
—— morio	Gray, fig. 6, p. 10, where also the dentition of *C. nodosus* and of *C. vespertilio* is described.
—— nodosus.....	
—— vespertilio	
Triumphis distorta	Description, Gray, p. 15.

Bullia and *Phos* are, in all probability, also members of this family; but only those genera or, more critically, those species have been introduced whose *Buccinoid* character has been determined by their lingual dentition, either actually figured or satisfactorily described. The list already includes some of the principal genera, and will, no doubt, be soon very considerably augmented when the information and research of other naturalists is brought to bear upon it in the manner above indicated.

Muricidæ.

Lingual dentition triserial, the distinctive feature of which is having strongly curved *simple* acuminate teeth in the pleuræ; and the origins of the central teeth are usually in bold relief upon the basal plates.

Systematic Name.	References and Remarks.
Murex tenuispina.....	Personal observation, preps. and drawings.
—— trunculus	Figured by Hogg, *op. cit.* pl. 10. fig. 35.
—— brandaris	Mr. Barron's preparations.
—— erinaceus	Forbes & Hanley, pl. TT. fig. 1 *c*.
Purpura lapillus	Mr. Barron's preparations; descrip. Gray, p. 20.
—— Blainvillii	Mr. Barron's preparations.
—— hæmastoma	Figured by Hogg, pl. 10. fig. 36.
Iopas Francolina	Mr. Barron's preparations.
Trophon bamfium.....	F. & H. pl. SS. fig. 3 *b*.
—— magellanicus	Mr. Barron's preparations.
—— clathratus.....	F. & H., description of axile tooth.
Monoceros imbricatum..	Figured by Troschel.
—— brevidentatum....	Mr. Barron's preparations.
Vitularia fiscellum	Description, Gray, p. 19.
Rapana	Characters of genus, Gray, p. 19.
Muricidea (*Sw.*)	Personal observation in the South Seas.
Fusus *or* Colus proboscidalis	I have found the dentition of this species to be as follows:—Axile plates broad, with a large central tooth, and a smaller one on either side of it. Pleural teeth simple, uncinate.
Hemifusus *or* Cochlidium tuba	Dr. Gray's description, p. 11 ("Teeth central, 3-toothed, lateral, hooked, versatile") may be contrasted with the above.

The present state of the two families to which I have confined my attention in this paper shows the utter impossibility of classifying the Gasteropoda by the purely conchological method of comparing shell with shell, independently of the light which we now know may be derived from the dental characters. On applying to the systems of Gray, Woodward, and Adams the plummet of the foregoing lists, it will be found that, though they differ considerably *inter se*, they all

differ more strikingly from the plummet, as shown in the following table:—

Buccinidæ determined by the Lingual Dentition.	System of Gray*.	System of Woodward†.	System of H. & A. Adams‡.
Buccinum	Buccinum	Buccinum	Buccinum
Cantharus	„	„	„
Pisania	„	„	„
Pusiostoma	„	„	„
Cominella	„	Cominella	Cominella
Chrysodomus	„	„	„
Nassa	„	Nassa	Nassa
Neritula	„	Cyclonassa	Neritula
Cassidulus	„	„	„
Triumphis	„	„	„
Muricidæ.			
Murex	Murex	Murex	Murex
Purpura	„	„	„
Iopas	„	„	„
Trophon	Trophon	Trophon	Trophon
Concholepas§	„	„	„
Monoceros	„	„	„
Vitularia	„	„	Vitularia
Rapana	„	Rapana	„
Muricidea	„	„	Muricidea
Fusus *or* Colus proboscidialis	„	„	„
Hemifusus *or* Cochlidium tuba	„	„	Hemifusus (*Sw.*)
Sistrum§	„	„	„

Were all the genera included in each system given *in extenso*, a very much greater difficulty would present itself to the mind of any one attempting to reconcile their differences. Enough has been said, however, to show that the lingual dentition would appear to be the only appeal. Indeed the effort to accomplish this desirable object in any other way would only lead to unscientific dispute, and develop no satisfactory result.

In a subsequent paper I shall consider the relationships of all the families of proboscidiferous Gasteropoda in which the central and often the pleural teeth point directly backwards without recurvature—in short, the Orthodontal Proboscidifera.

Haslar Hospital, Sept. 11, 1868.

* Guide to Mollusca, vol. i.
† Manual of Mollusca.
‡ Genera of Mollusca.
§ Omitted in Muricidæ above.

XXVII.—*Notulæ Lichenologicæ.* No. XXIII.

By the Rev. W. A. Leighton, B.A., F.L.S.

Dr. Nylander has published, in the 'Bulletin of the Botanical Society of France' (t. xiii. pp. 364 &c.), a very interesting account of the lichens which he collected in the garden of the Luxembourg Palace at Paris. Independently of the valuable lichenological information it comprises, it is an instructive example of what diligent and accurate research may accomplish in a circumscribed space, and a proof that botanists need not go far afield for their collections, but that treasures lie at their very doors, if only their eyes and hearts will look for and appreciate them.

The paper is prefaced by some remarks which, excellent in themselves, are also highly suggestive in various ways. Of all plants, lichens are the most extensively diffused, living on barks, woods, rocks, stones, and earth, especially when these substrata are located in a pure fresh air, which is absolutely essential to their nourishment and healthy development. Most lichens, as a general rule, avoid towns, and if they make their appearance there, are most frequently found in a state of incomplete development, either sorediate or entirely sterile. There are, indeed, some few species (as *Physcia parietina*, *Ph. pulverulenta*, var. *pityrea*, *Ph. obscura*, *Ph. stellaris*, *Placodium murorum*, *Pl. callopismum*, &c.) which willingly inhabit cultivated places; but in the interior of great towns we may generally search in vain for them on the trunks of trees and on the walls. In such localities their usual abodes are occupied by Cryptogams of an inferior order (such as *Protococcus*), which delight especially in an impure air, or one surrounded with houses or walls. Lichens, on the contrary, refuse to live in such conditions. The trunks of trees in the gardens and plantations of great towns are for these reasons destitute of all trace of lichens. On the other hand, in the open country every tree is more or less adorned with thalli and apothecia of divers colours. The magnificent trees of the gardens of the Tuileries bear scarcely anything but *Protococcus*. In the Jardin des Plantes scarcely any trees bear lichens, and those only in the most exposed places.

We may observe, *en passant*, that lichens are by no means parasites, properly so called; and it is at least very doubtful whether they are injurious to the trees upon which they grow. All that can be said is that they may to a certain extent be injurious to the living bark, either by obstructing its respiratory functions or by applying to its surface an excessive humidity.

The garden of the Luxembourg, by reason of its more favourable situation, is less destitute of lichens than any other public walk in Paris. Consequently lichens constitute in some degree a standard of the salubrity of the air, and a very sensitive hygrometer. The sweet-chestnuts in the Observatory avenue are especially remarkable for the numerous lichens growing on their bark, and which are in such abundance as generally can only be found at a considerable distance from a town. We are thus authorized to assert that this portion of the Luxembourg is the most healthy spot of all Paris.

Diligence has rendered the list as perfect as possible; but it should be remarked that those portions of the garden from which the public is excluded may possibly have furnished some additions.

The number of lichens enumerated is about forty; they are as follows:—

1. *Parmelia acetabulum* (Neck.), Dub. Forma virescens sterilis.

2. *Physcia parietina*, L. Frequentissime fertilis. And also forma thallo virescente, and a var. *sorediosa* marginibus thalli sterilis sorediosis.

3. *Physcia stellaris* (Ach.) typica et var. *tenella*, Scop. Sterilis.

4. *Physcia obscura* (Ehrh.), var *sorediosa*. Sterilis.

5. *Physcia pulverulenta*, var. *pityrea* (Ach.). Sterilis.

6. *Lecanora* (*Squamaria*) *saxicola* (Poll.). Rara.

7. *Lecanora* (*Placodium*) *murorum* (Hffm.), Ach., Nyl. L. Paris. 119. Fertilis. K+.

Var. *corticicola*. Forma thallo contracto. K+.

8. *Lecanora* (*Placodium*) *callopisma*, Ach., Nyl. L. Paris. 36. Differt a *L. murorum* thallo; sporis crassioribus et paraphysibus apice clava minore.

9. *Lecanora citrina*, Ach., Nyl. L. Paris. 35. Sterilis. Like *L. epixantha*, Ach., but with different chemical reaction: *L. epixantha*, K−, *L. citrina*, K+.

10. *Lecanora* (*Placodium*) *teicholyta*, Ach. Raro fertilis.

11. *Lecanora candelaria*, Ach., Nyl. Syn. i. 412; Lich. Scand. 108 (*Physcia*). K−. Sterilis.

A speciebus analogis *Physciæ* longe differt reactione chrysophanica nulla.

12. *Lecanora medians*, Nyl. in Bull. Soc. Bot. de Fr. t. ix. 1862, p. 262, sub *Placodio*. Haud raro fertilis.

K−. Distat itaque *L. medians* absolute ab extus subsimili *L. murorum*, sed affinis est *L. vitellinæ* et præcipue *L. crenatæ* Nyl. (*crenulata*, Whlnb.).

13. *Lecanora vitellina*, var. *epixantha* (Ach. L. U. 208, sub *Lecidea*), Nyl. L. Scand. 141. Sæpius fertilis. K−.

14. *Lecanora cerina* (Ehrh.), Ach. Forma thallo cinereo turgescente rugoso; fertilis.

15. *Lecanora pyracea*, f. *pyrithroma*, Ach., Nyl. Scand. 145. Forma *rupestris* (Scop.), Nyl. *l. c.* Sporis 1-sept. variantibus septo crassiore.

16. *Lecanora sophodes*, var. *teichophila*, Nyl. Fertilis. Var. *exigua*, Ach. Nyl. Scand. 152.

17. *Lecanora circinata* (Pers.), Ach., Nyl. Scand. 152. Fertilis.

18. *Lecanora galactina*, Ach., Nyl. *l. c.* 134 (sub *Squamaria*). K−. Gel. hym. iodo cærulescens, deinde sæpe vix nisi thecæ sic tinctæ.

Note.—*Lecanora dispersa* (Pers.) = *L. galactina* ecrustacea. Apothecia *L. dispersæ* livido-pallescentia vel subcornea aut nigrescentia pruinosa, margine albo crenulato vel obsolete crenulato (sæpe subintegro vel farina epithallina alba crenulato), trita obvenientia margine proprio subconcolori demum explanato; sporæ 8, ellipsoideæ simplices; paraphyses gracilentæ (sæpius apice incrassatæ ibique granulationibus inspersæ). K−.

19. *Lecanora urbana*, Nyl. Thallus albus opacus granulato-squamulosus, granulis depressis crenatis, mediocris; apothecia pallido-subincoloria leviter albo suffusa conferta mediocria, margine thallino subcrenulato cincta, sæpe subangulosa; sporæ 8, ellipsoideæ; paraphyses crassiusculæ, articulatæ, apice incolori, non clavatæ. Gel. hym. iodo cærulescens, dein vix nisi thecæ (sordide violaceo vel cærulescenti) tinctæ. Ad lapides, Rue de l'Ouest.

Note.—A *L. galactina* præsertim differt thallo firmiore purius albo et paraphysibus duplo vel triplo crassioribus distincteque articulatis.

Comparanda est cum *L. galactina* nova species in regione Parisiensi vigens *Lecanora teichotea* cui thallus albidus subradiato-rimosus, ambitu placodioideo effiguratus; apothecia fusco-rufa convexiuscula, margine thallino crenulato cincta; sporæ 8, ellipsoideæ; paraphyses capitulo lutescente; spermogonia incoloria (extus solum puncto obscuro indicata), spermatiis arcuatis. Pertinet vero hæc ad aliam stirpem Lecanorarum; thallus C+ erythrinicam dilutam. Affines *L. teichoteæ* sunt *L. pruinifera*, Nyl. (*L. pruinosa*, Chaub. in St. Am. Fl. Ag. 497, nomen non retinendum ob idem alii datum) et *L. Reuterii*, Schær., quarum thalli C+ erythrinice.

20. *Lecanora dissipata*, Nyl. Thallus præcipue hypothallo nigricante subleproso indeterminato constans; apothecia sub-

incoloria vel livido-pallida leviter albo suffusa minora, sat conferta, margine thallino albo opaco subintegro vel obsolete crenulato cincta; sporæ 8, ellipsoideæ; paraphyses haud bene discretæ.

Ad lapides murorum.

L. dissipata (comparanda cum *L. dispersa*) differt ab *L. urbana* hypothallo, apotheciis dispersis minoribus, paraphysibus vix articulatis et minus bene discretis (addito ammoniaco distinctiores et evidentius articulatæ conspiciuntur). Gel. hym. in omnibus tribus similiter iodo tingitur et gonidia in iis abundantia sub apotheciis.

21. *Lecanora parisiensis*, Nyl. n. sp. (vel potius var. *L. subfuscæ*). Thallus cinereus, mediocris, rugosus vel rugoso-granulatus vel subverrucosus, sat determinatus, hypothallo non visibili; apothecia nigra vel fusco-nigra vel rarius fusca, nuda (interdum leviter cæsio-pruinosa), mediocria, planiuscula, margine thallino rugoso vel subcrenato cincta, strato subjacente gonidico læte viridi; sporæ 8, ellipsoideæ; paraphyses distincte articulatæ, apice leviter incrassatæ, et sat late fuscescentes. Gel. hym. iodo cærulescens (deinde thecæ vulgo solæ sic vel nonnihil violaceo tinctæ).

Ad corticem præsertim æsculorum. K+.

Differs from all varieties of *L. subfusca* by its thick articulate paraphyses, but chiefly approximating var. *allophana*, Ach., which has larger spores and slenderer paraphyses.

22. *Lecanora scrupulosa*, Ach., Nyl. Scand. 162. Gel. hym. iodo vinose rubens. K+.

23. *Lecanora umbrina* (Ehrh.), Ach., Nyl. *l. c.* (forma *cyanescens*, Ach.). K−.

Note.—*Lecanora Flotowiana*, Anz. Manip. 53 = *L. umbrina* saxicola = *Lecidea pelidna*, Ach. K−.

Lecanora Sommerfeltiana, Krb. Lich. Sel. 99 = *L. crenulata*, Dicks., Nyl. L. Par. 123; Heppe, 63. K−.

Lecanora Sommerfeltiana, Heppe, 61 = *L. dispersa*, Pers. K−.

24. *Lecanora erysibe* (Ach.), Nyl. Scand. 217.

25. *Lecanora depressa* (Ach.), var. *calcarea* (L.), Nyl. *l. c.* 154.

26. *Lecidea parasema*, var. *enteroleuca*, Ach., Nyl. *l. c.* 217. Etiam f. *synothea*, Ach.

27. *Lecidea albo-atra*, var. *athroa* (Ach.), Nyl. *l. c.* 235.

28. *Arthonia tenellula*, Nyl. in Flora 1864, p. 488. Vix nisi var. *A. patellulatæ*, Nyl. Scand. 262.

29. *Verrucaria sorediata*, Borr. (*V. Garovaglii*, var. *incrustans*, Nyl. Prodr. Gall. 179, Pyrenoc. 20).

30. *Verrucaria virens*, Nyl. Pyrenoc. 25, Scand. 270, var. *obfuscans*.

31. *Verrucaria nigrescens*, Pers., Nyl. Scand. 271.
32. *Verrucaria fuscella*, Turn., Ach. Nyl. *l. c.* 271.
33. *Verrucaria rupestris*, Schrad., Ach., Nyl. Pyrenoc. 30; Scand. 275 (*Lichen immersus*, Hffm., Pers.; *V. galactina*, Mass., Anz.).

It may be noticed also that *Capnodium* profusely covers the upper portions of the branches of the trees with its thin, black, unequal, areolato-diffract crust, which has every appearance of a crustaceous lichen, but with the texture of the mycelium of *Fumago*, and is always sterile. It may be called *Fumago circumvagans*, and may be regarded as a form or variety of the common *Fumago vagans*.

Parmelia	1
Physcia	7
Lecanora	23
Lecidea	3
Arthonia	1
Verrucaria	5
	40

XXVIII.—*Report on the Annelids dredged off the Shetland Islands by Mr. Gwyn Jeffreys in* 1867. By W. C. M'Intosh, M.D., F.L.S.*

Mr. Gwyn Jeffreys, in his dredging-expedition to the Shetland Islands last year, kindly selected, chiefly with the assistance of Mr. Sturges Dodd and the Rev. A. M. Norman, a large number of Annelids, which he most courteously placed at my disposal; and, as they were properly preserved in vessels and fluid sent for the purpose, their subsequent examination proved very satisfactory.

The majority of the Annelids come from St. Magnus Bay, or, rather, from the deep water (80–100 fathoms) beyond this, not because they so disproportionately abound there (although the muddy sand is eminently favourable for their increase), but probably because the dredging was most frequently carried on in that neighbourhood. The other localities, in the order of the respective collections, are off Balta, North Unst, Bressay Sound, Outer Haaf (Skerries), and (a small shore collection made by Mr. Dodd) at Hillswick.

* Communicated by the Author, having been read at the Meeting of the British Association at Norwich, August 20, 1868.

The Annelids found in the deep water off North Unst form a collection very rich in new or rare forms; for, out of thirteen species, three at least are new to science, and four not hitherto found in Britain. The collection from the Outer Haaf, Skerries, has also several rare forms; out of eight, four are new to Britain and one to science. Out of sixty found in St. Magnus Bay, four are new to science and eighteen to Britain. These figures contain the entire new or rare forms in the individual collections, without reference to their occurrence in others, as will be apparent when I mention that, out of a total of about ninety-two Annelids at present identified, five or six, so far as I can make out, are new to science, and about twenty-two to Britain. As before stated, this is one of the best collections of the kind ever made in Britain, whether we regard the excellent condition of the preparations or the number of new forms. As might be expected, many of the additions to our fauna are Scandinavian in type; but others are not so, at least they do not occur in the valuable catalogue recently published by Dr. A. J. Malmgren, the enterprising naturalist of Helsingfors.

I have described some of the supposed new forms elsewhere, and therefore shall merely name them; others have not yet been noticed. They are as follows:—*Hipponoë Jeffreysii*, n. sp., a small Amphinomacean. *Eunoa* ——, the second species of the genus found in Britain, the first being *E. nodosa*, Sars, also found in the Shetland seas by Mr. Jeffreys, and described by Mr. Lankester as a new form, under the name of *Antinoë zetlandica**; in the present species the scales are quite smooth, often bordered with a dark pigment-belt, and the inferior bristles of the feet have an entire clawed tip. *Sigalion Buskii*, n. sp., a species having the general aspect of *S. boa* rather than that of *S. Mathildæ*, to which the scales are most nearly allied in structure; but the bristles are longer than in either case, and characteristically different. *Notocirrus scoticus*, n. sp., a Lumbrinereian with a dorsal branchial lobule to each foot. *Eumenia Jeffreysii*, n. sp., a form dredged last year in the Hebrides, but too much decomposed to be minutely described: it is allied to *E. crassa*; but there are no traces of branchial filaments. *Praxilla artica* (? Mgrn.), a species that very probably is *P. artica*†, Malmgren; but as that author has only mentioned that it is similar to *P. prætermissa* (differing in the hooks having six teeth), we are left quite in doubt as to his form. *Polycirrus* (?) *tribullata*, n. sp., a species having the snout and tentacles of a *Polycirrus*, but without bristles or hooks in the

* Trans. Linn. Soc. vol. xxv. p. 377, tab. 51. figs. 13, 17, 18, 22, & 23.
† Annulata Polychæta Spetsbergiæ, &c., 1867, p. 100.

anterior region, which, however, is furnished with three circular and somewhat flattened papillæ on each side.

Of the forms new to Britain are :—*Harmothoë longisetis*, Grube[1], which, however, I think, is *H. Malmgreni*, Lankester[2], and thus has been previously got in this country. *Sigalion limicola*, Ehlers[3]. *Nephthys ciliata*, Müll.[4] *Genetyllis lutea*, Mgrn.[5] *Anaitis kosteriensis* (?), Mgrn.[6] *Lumbrinereis fragilis*, Müll.[7], a species which probably includes *L. tricolor* and some others, and therefore has been found previously on British shores. *Onuphis sicula*, Quatref.[8], a curious species (inhabiting a tube composed of shell-fragments, stones, and sand), allied to *O. tubicola*, but differing entirely in the structure of certain of its bristles. *Eone Nordmanni*, Mrgn.[9] *Scoloplos armiger*, Müll.[10] *Naidonereis quadricuspidata* (Fabr.), Œrst.[11] *Trophonia glauca*, Mgrn.[12] *Chætopterus norvegicus*, Sars[13], a species which apparently comprehends *C. insignis*, Baird[14]. *Scolecolepis cirrata*, Sars[15]. *Axiothea catenata*, Mgrn.[16] *Praxilla prætermissa*, Mgrn.[17] *Praxilla gracilis*, Sars[18]. *Clymene ebiensis*, Aud. & Ed.[19] *Ampharete artica*, Mgrn.[20] *Sabellides sexcirrata*, Sars[21]. *Grymæa Bairdi*, Mgrn.[22] *Euchone analis*, Kröyer[23]. *Chone infundibuliformis*, Kröyer[24].

Besides the foregoing, there are several whose examination, partly from their fragmentary state, has not been completed,

[1] Archiv für Naturges. 1863, tom. xxix. p. 37, Taf. 4. fig. 1.
[2] Trans. Linn. Soc. vol. xxv. p. 375, tab. 51. figs. 11, 25, 28.
[3] Die Borstenwürmer &c. p. 120, Taf. 4. figs. 4–7, & Taf. 5.
[4] Zool. Danica, tab. 89. figs. 1–4.
[5] Nordiska Hafs-Annulater, 1865, p. 93, tab. 14. fig. 32.
[6] Annulat. Polychæt. &c. p. 20.
[7] Prodr. Zool. Dan. p. 216; Zool. Danic. i. p. 22, tab. 22. figs. 1–3.
[8] Hist. Nat. des Annelés, i. p. 352.
[9] Nord. Hafs-Annul. p. 409, & Ann. Polychæt. p. 69, tab. 11. f. 64.
[10] Zool. Dan. i. p. 22, tab. 22.
[11] Grönlands Annulat. Dorsibr. p. 200, figs. 106–110.
[12] Annul. Polychæt. p. 82, tab. 13. f. 78.
[13] Beskriv. og Jagttagelser &c. p. 54, pl. 11. fig. 29.
[14] Trans. Linn. Soc. vol. xxiv. p. 477, tab. 49.
[15] Nyt Mag. vi. p. 207 &c. (fide Malmgren).
[16] Nord. Hafs-Ann. p. 190, & Ann. Polych. p. 99, tab. 10. fig. 59.
[17] Nord. Hafs-Ann. p. 191, & Ann. Polych. p. 100, tab. 11. fig. 62.
[18] Fauna litt. Norveg. ii. p. 15, tab. 2. figs. 18–22.
[19] Figured in Règ. An. iii. pl. 22. fig. 4.
[20] Nord. Hafs-Ann. p. 364, tab. xxvi. f. 77.
[21] Fauna litt. Norveg. ii. p. 24.
[22] Nord. H.-Ann. p. 388, tab. 19. f. 69.
[23] Danske vid. Selsk. Forh. p. 17.
[24] *Op. cit.* p. 33.

and which are at any rate in the same category, viz. a *Sigalion*, a *Syllis*, an *Autolytus*, an *Amage*, and a *Polycirrus*.

I may also remark, in passing, with reference to some of the other known forms found in this collection, that the *Halosydna Jeffreysii*, Lankester*, is *H. gelatinosa*, Sars†, as mentioned in Dr. Günther's Zoological Record for 1866, and that I have not yet been able to make out a specific difference between *Leodice norvegica*, Linn., and *Eunice Harassii*, Aud. & Ed.‡

In addition to the Annelids proper, there were some Planarians, Ommatopleans, Borlasians, and a very remarkable form allied to the latter group, with a bifid proboscis—besides a boring *Sipunculus*, lodged in its cavity inside a fragment of shell.

XXIX.—*On the Production of the Sexes in Bees.*

By Félix Plateau, D.Sc.

To the Editors of the Annals and Magazine of Natural History.

Ghent, Sept. 9, 1868.

Gentlemen,

Having been occupied for a long time with investigations upon the parthenogenesis of the Invertebrata, I have read with eagerness the interesting notice by M. von Siebold "On the Law of Development of the Sexes in Insects," in which the learned Professor endeavours to refute the assertions and experiments of M. Landois.

The theories of Dzierzon and of Von Siebold, ingenious as they are, and notwithstanding the numerous facts which are cited in their support, seem nevertheless to be so much in contradiction to our general knowledge of the reproduction in the higher animals, that researches such as those of M. Landois should be received with favour, and we ought to take care not to reject them without having exhausted all possible arguments in connexion with them.

M. von Siebold, indeed, passes over in complete silence some very important observations which seem to me to be entirely in favour of M. Landois. Androgynous or hermaphrodite bees have been remarked long since by a schoolmaster named Lucas; and more recently this monstrosity has been observed by MM. Doenhoff, Menzel, and Engster;

* Trans. Linn. Soc. vol. xxv. p. 377, tab. 51. figs. 12, 19, 26.

† Beskriv. og Jagtt. &c. 1835, p. 63, pl. 9. fig. 25.

‡ Hist. Nat. du Litt. de la France, ii. p. 141, pl. 3. fig. 5, 6, 7, 10, & 11.

lastly, in 1864 and 1865, M. von Siebold himself and M. Leuckart paid attention almost simultaneously to this singular fact, which is far from being rare *.

I shall not enter upon this subject in much detail; it will be sufficient for me to say that in the androgynous bees there is a mixture of male and female characters varying from one individual to another, and which is met with in a number of organs both internal and external; very often we find simultaneously, on each side of the body, a few testicular coils and a few ovarian tubes, a well-developed male copulatory apparatus, and a sting, although the sting is wanting in the male. According to M. Leuckart all the hermaphrodite individuals (of which he examined about fifty) must be regarded as *workers* presenting certain male characters.

Here, therefore, we have bees in which the genital and other organs have been developed at once in the male and in the female direction—an evident proof that the larva has no sex before a certain period (the sixth day), and that an influence which exists outside it causes it to deviate subsequently, either towards the male or the female type.

Moreover certain animals, such as the Aphides, according to the beautiful investigations of M. Balbiani †, of which M. von Siebold likewise says nothing, commence by having the two sexes united and in the same state of development. The viviparous Aphides are and remain hermaphrodites: in the oviparous Aphides, when the embryo is to become a female insect, the male organs retain their rudimentary character, while the female organs increase; on the contrary, when the individual is to be a male, the female part of the original hermaphrodite apparatus becomes transformed into a true testicle, the cells which it contains becoming fusiform follicles filled with spermatic corpuscles. Finally, the male apparatus does not disappear, and exists, after birth, in the oviparous individuals of both sexes with characters which scarcely differ in any respect from those which it presents in the viviparous Aphides.

To return from this to the causes which may determine the formation of the sexes in bees. It is possible that M. Landois

* Von Siebold, "Ueber Zwitterbienen," Zeitschr. für wiss. Zool. xiv. p. 73; Bibl. Univ. Archives, xx. p. 64. Leuckart, "Ueber Bienenzwitter," Bericht über die Versammlung deutsch. Naturf. und Aerzte, 1865, iii. p. 173; Bibl. Univ. Archives, xxv. p. 172.

† Comptes Rendus, tome lxii. pp. 1231, 1285, 1390; Ann. & Mag. Nat. Hist. ser. 3. xviii. pp. 65 and 106 (but see M. Claparède's observations on Balbiani's researches, Ann. des Sci. Nat. 5e sér. vii. p. 21, and Ann. & Mag. Nat. Hist. ser. 3. xix. p. 360).

deceives himself in ascribing the production of males to insufficiency of nourishment; but would not the intimate composition of this nourishment have an influence? Given a very young worker-larva, the genital organs of which may equally become male or female, as is indicated by the hermaphrodite bees, since a special nourishment may make of it a queen, according to Schirach* and the bee-keepers, one is led to assume, until *incontestable* evidence to the contrary is obtained, that the food may also force the male reproductive organs, which exist in a latent state, to become developed to the exclusion of the others.

Would not the form of the cells also play its part? for it is certainly not without motive that the lids of the male cells are convex.

Permit me to add a few words with regard to the very recent investigations of MM. Sanson and Bastian, which, far from invalidating those of M. Landois as those authors think, only serve to confirm them, in my opinion.

MM. Sanson and Bastian† cut away from a male cell the bottom part which bears the egg, remove the bottom of a worker-cell, and substitute for it the preceding piece, which they fix by passing a hot needle along its margins.

Like M. Landois and M. Bessels, who have made analogous experiments, MM. Sanson and Bastian remove the queen, so as to avoid mistaking for the eggs which they have placed artificially others subsequently laid by the female.

The ninety-three male eggs introduced by the method just described were regularly expelled by the workers, from which MM. Sanson and Bastian conclude that the experiments of M. Landois are erroneous.

But we may remark that the process employed by this last-mentioned observer is entirely different. Knowing well that the worker-bees promptly cleanse the cells of all foreign bodies, he carefully avoided mutilating the cells after the fashion of MM. Sanson and Bastian, whose handiwork, which would certainly be very coarse for bees, would be immediately recognized by them. He delicately removed the egg with a very small fragment of wax, and stuck it into the interior of the new cell, by means of this little fragment, in the most natural position possible. Under these conditions the author saw the eggs of workers transported into male-cells give birth to drones.

MM. Sanson and Bastian introduced into an artificial hive,

* Histoire Naturelle de la Reine des Abeilles. Trad. Blassière, 1771, p. 45.

† Comptes Rendus, tom. lxvii. p. 51.

composed exclusively of male cells selected elsewhere, some living workers and their queen; all the bees produced in these cells were workers. I see nothing in this opposed to the theory of M. Landois; the eggs deposited in the drone-cells furnished workers because the bees had furnished them, *after deposition*, with worker food. We may add, in support of this opinion, that the queen had deposited two eggs which the workers destined to the production of males, as they closed the cells with convex lids. But they afterwards destroyed these eggs, because it was exactly at the season (very ill-chosen by MM. Sanson and Bastian) when they kill the drones.

Lastly, what, it seems to me, must give the cause to M. Landois, is that MM. Sanson and Bastian have seen deposited in worker-cells eggs which gave origin to males. These two naturalists, indeed, endeavour to explain the fact by means of Dzierzon's theory. The queen, they say, was old, and her spermatic reservoir no longer contained a sufficiency of spermatozoids, for it was semitransparent. Now, if the seminal receptacle is opaque when it is completely full, it is perfectly transparent when empty, and it seems to me that when we find it only semitransparent, it will still contain far too many spermatozoids to allow the observer to think that the eggs have not been fecundated.

XXX.—*On the manner of Fertilization of the Scarlet Runner and Blue Lobelia.* By T. H. Farrer, Esq.

To the Editors of the Annals and Magazine of Natural History.

Gentlemen,

The following notes of observations on the fertilizing-apparatus of the scarlet runner and the common blue lobelia, made by one who has not the slightest pretence to scientific knowledge, would never have been sent to the press, but for the kind suggestion of Mr. Charles Darwin, to whom they have been communicated. That these interesting facts, if not mentioned by previous observers, should have escaped his notice never occurred to me for a moment, although at the time this paper was written I had not seen his papers on the fertilization of the kidney bean in the 'Gardeners' Chronicle' of the 24th of October 1857 and the 14th November 1858, which he has kindly sent me. In these papers the structure and functions of the kidney bean are fully given, with his own interesting experiments; and though in them the details of the lobelia

are not given, there is a reference to that flower which shows clearly enough that they had not escaped him.

Whatever these facts are worth, they are the obvious results of Mr. Darwin's own most suggestive papers on *Primula*, *Linum*, and *Lythrum*, referred to in such high terms by Dr. Hooker in his Norwich address. To an amateur, dismayed by the difficulties of botanical classification, perplexed by his own incapacity for microscopical dissection, and disgusted by the mere cataloguing of species, Mr. Darwin's suggestion that the true account of the structure and functions of flowers is frequently to be found in their capacity for fertilization, and especially in their capacity for cross fertilization with the pollen of other flowers, is a ray of light which opens out an endless field of interesting observation. And to those who look in science for wider speculations, the grand generalization contained in these and other papers of Mr. Darwin's, to the effect that fertility in the animal and vegetable world requires the union of elements which are neither identical nor dissimilar, but different and yet similar, with all its consequences, affords endless matter for thought, whilst it receives life and reality from the minute observations of details in which his papers abound, and of which they set such wonderful and stimulating examples. I know of no writings which so well illustrate the axiom of the great German poet and observer—

"Was fruchtbar ist, allein ist wahr."

Sept. 17, 1868. T. H. Farrer.

Mechanism for transporting Pollen in the Scarlet Runner (Phaseolus coccineus).

The two wings are united to the back and outside of the keel some little distance above the base of both; their blades fold backwards from the centre towards the outside, and, by the bending of the spiral keel, with the pistil and stamens inside it, the wings are thrust a little to the right hand, so that the folded or bent blade of the left wing is opposite to the coil of the keel, and is the natural place on which any insect seeking to reach the bottom of the flower would alight. The lower parts or claws of the wings remain upright, and are firm and elastic.

The keel encloses the stamens and pistil from a point a little above the ovary, and at the upper end the margins are joined so as to form an imperfect tube: it makes together with them nearly two complete turns, of which the upper one and a half lie close above one another in the same plane. This plane is inclined at a small angle to the blade of the left wing, and is so placed that the mouth of the spiral tube points obliquely

downwards and towards the base of the left wing. To a spectator looking into the flower, the way, if any, to the base of the petals and of the ovary is obviously down the left wing and past the mouth of the spiral tube; but there is hardly room, in the quiescent state of the flower, even for the proboscis of an insect between the base of the wing and the keel.

On following the development of the flower in the bud, it appears that the peculiarity of the spiral coil of the keel, with its enclosed stamens and pistil, only appears at a late stage. In the earlier stage, though the anthers and the brush round the style are fully formed, the length of the style, filaments, and keel, and the form of the keel, are like those of other papilionaceous flowers.

The filaments of the stamens, which are, except one, united and stiff at the base, are in the upper part very thin and flexible, and follow the windings of the spiral keel. The anthers, which are small, lie in two rows entirely within the tube or hollow of the keel, a little within its mouth, and within and below the stigma.

The pollen is not very abundant, and is not dry and dusty, but moist and sticky.

The style is stout, strong, and very elastic; it is set firmly on the stiff upright ovary, so that its point of attachment to the ovary and base of the flower is at some distance from that of the attachment of the keel to the stiff claw of the wing. The stigma is at the extremity of the spiral coil, and on the lower or outer side, *i. e.* on the side next the wings; it is sticky, and is clothed with fine hairs. In the untouched flower it just protrudes out of the mouth of the tube of the keel, so that its tip is just visible on looking downwards into the flower. A little below it the style is clothed with stiffish hairs or bristles, which partly encircle the style like a circular brush, but which are considerably more in number on the upper or outer side of the coil than on the inner or under side. This brush is opposite to and in contact with the opening anthers.

Under these circumstances it is not obvious at first sight how the flower is fertilized. As regards self-fertilization, the arrangement does not seem a happy one; for the stigma is outside and below the tube of the keel, whilst the anthers and pollen are shut up within it.

The plants are frequented by, indeed they swarm with, bees. These are of various kinds, of which I do not know the names. But, so far as I could see, the smaller or hive-bees never succeeded in getting what they wanted through the mouth of the flower. They occasionally lighted on the petals, and looked in, but invariably went round to the back of the flower, and

there sometimes remained and sometimes went away disappointed. When they remained, they inserted their proboscides into a hole bored through the calyx, the petals, and the staminal tube. I never saw them bore these holes, though every flower where they remained had them. One humble-bee, however, (black, with two yellow bars on his back, and a light-coloured tail) certainly did bore or, rather, nip these holes; and this bee invariably adopted the same plan, and never looked at the mouth of the flower. But by far the greater number of the larger bees alighted on the wings, or, rather, generally on the left wing of the flower, and inserted their proboscides down the apparent natural channel towards the base of the flower. So far as I saw, the same bees always adopted the same course. In alighting on the wing of the flower, they weighed it down, and in so doing pressed outwards the stiff elastic lower part or claw. On doing the same thing with one's finger, it became obvious that the bee thus opened for its proboscis a clear path to the hollow between the claw and the staminal tube, and also to the base of the separate stamens, between which and the other stamens would be his access to the hollow surrounding the ovary. The tendency of pulling back the keel is to widen the openings between the separate stamen and the others; and there is a curious appendage outside the base of the separate stamen, which lies exactly in the path of the bee's proboscis, and which, when pressed, pulls the separate stamen back towards the vexillum, and leaves free access to the ovary. From the vigorous sidling struggles the bees constantly made, it looks as if they were trying in this way to get to the inside of the staminal tube, which I see is always penetrated by the bees which bore holes.

But, however this may be, it clearly appears that the same bending down of the wings of the flower which opens for the bees a way to its base, produces another and a very curious effect on the style. The lower part of the wings of the flower being attached to the lower and outer part of the keel, when the former is bent outwards, it pulls the base of the keel outwards too. The effect of this is to pull the upper spiral coil or tube of the keel backwards also, and at the same time to contract it. The style, which before had been exactly adjusted to the length of the keel, now becomes too long for it, and, in consequence of the stiffness of the lower part and the wiriness of the upper part of the style, the tube of the keel is pulled backwards on the style, or, which is the same thing, the coil of the style is pushed forwards through the tube, so as to thrust the upper end of the style quite out of the tube, and expose the whole of the stigma and the bristles below it. In

consequence of the direction and contraction of the spiral coil, this protrusion of the stigma is at first made in a direction rather outwards than upwards, towards the blade of the left wing of the flower; but as the thrust continues, the stigma turns more and more upwards. The anthers remain in their place within the tube, in consequence of the thin thread-like character of the filaments, which crumple up, and have not, like the stiff elastic style, the power to thrust themselves outwards. Consequently the anthers are passed over and swept by the brush of the style.

The result of these movements is that when the bee first inserts his proboscis into the flower, the stigma will exactly meet and sweep the base of it, and will brush off from it and keep a large part of any pollen it may have brought from other flowers. As the bee presses the wing of the flower further back, the style comes out further; the stigma turns upwards away from the insect, and that part of the style which is covered with hairs comes in contact with the base of the proboscis. In coming out of the tube or hollow of the keel this brush has been forced against and has swept the sticky pollen out of the anthers, and is covered with it; and, in consequence of the position of the hairs and the direction of the thrust, the pollen is especially thick on the side of the style which is next the bee. As he struggles and twists to get the nectar, abundance of the pollen is deposited on and clings to the base of his proboscis, as may be seen by thrusting any pointed object into the flower. When he quits the flower, its wing springs back to its original place: the keel of the flower does so also, and the end of the elastic style retreats to its own old position within the hollow of the keel. But it does not do this very quickly; and as the bee's motion, and especially that of his proboscis, is very rapid, his proboscis must be withdrawn before he ceases to weigh down the wing, and at any rate before the stigma retreats. It follows that his proboscis will not, in retreating, be touched or swept by the stigma; and the last thing it will touch in leaving the flower will be the pollen-covered brush of the style, from which it will carry off an abundant load of fresh pollen, to be deposited in its turn on the stigma of the next flower.

I found the base of the proboscides of some bees which I caught covered with the pollen. I also found the stigmas of flowers which had opened in a room, and were not visited by bees, quite free from pollen, although, on pressing down the wing of the flower, the brush of the style was seen to be covered by it. On the other hand, the stigmas of the flowers visited by bees were always covered with pollen.

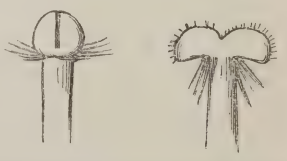
If the above observations are correct, this looks like a very curious and elaborate mechanism in order to secure the fertilization of one flower by the pollen of another. The form and position of the wings, their partial cohesion with the keel, the spiral and partly tubular keel, the delicate flexible filaments of the stamens, the moist and sticky pollen, the strong elastic column of the style, its spiral form, the position and character of the stigma, the brush that sweeps out the anthers, the motion of the style on the bee's visit (which first brings the stigma into contact with his proboscis, and then, when it has swept him clear of the pollen of a former flower, brings the brush loaded with its own pollen into contact with the proboscis, and deposits its load with him, and finally allows him to withdraw without touching the stigma again) are surely a number of very remarkable and elaborate adaptations, all apparently tending to the transportation of pollen from one flower to another.

Mechanism for Fertilization of the common Blue Lobelia.

The *corolla* has a broad lip or lower side, so as to afford a standing-place to insects; the tube is slit on the upper side, so as to afford play to stamens and pistils.

The *stamens* have hard, syngenesious anthers, and separate, flexible filaments, which are attached to the calyx at some distance from the base of the style, so that they look like shrouds to a mast. The two on the lower side are the shortest when the flower opens, and look as if they pulled the anthers downwards.

The *anther-tube* is open at the top in the early bud, but closes before the flower opens, and then again opens by a very small aperture, which is at this stage, in consequence of the bending over of the upper anthers, pointed downwards at right angles to the mouth of the tube of the corolla. Out of the top of the connective of the two lowest anthers grows a cluster of short thick bristles in a downward direction across the mouth of the tube of the corolla. The anthers are very hard externally, and internally very soft; they open inwards when the flower opens. There is an abundance of dry powdery yellow pollen.



The style is surrounded immediately below the stigma by a ring of bristles, which are developed in the bud at an early stage, and point outwards and upwards until the stigma is fully developed. The stigma remains inside the anther-tube when the flower first

opens; after a time, it protrudes. It has two lobes, but they are folded or pressed together when the flower first opens, and then only expose their perfectly smooth outer or lower sides. When the stigma protrudes from the anther-tube, the lobes open, the smooth outer surface is turned back, the ring of bristles is reflexed on the style, and the upper or inner stigmatic surface of the lobes, covered with short hairs or papillæ, makes its appearance below the mouth of the anther-tube, where it faces outwards and downwards, so as to meet anything which is thrust into the tube of the corolla.

When the flower first opens, the length of the style, as compared with that of the stamens, is such that the closed stigma with its ring of spreading bristles is at the bottom of the anther-tube. The style grows rapidly, sweeping the pollen with its ring of bristles, and pressing it towards the mouth of the anther-tube. Towards the end of this stage of growth, the style becomes so long relatively to the stamens, that it presses towards or against the mouth of the anther-tube like a spring. If at this stage a bit of the top of the anther-cases is cut off, the compressed pollen is forced outwards with quite a spirt.

It is clear that the principal function of all this apparatus is not to fertilize the stigma with the pollen of its own flower. The back of the stigma, which is smooth and has no papillæ, alone comes in contact with that pollen, and the stigmatic surface is only displayed when the pollen of its own flower is nearly all expelled from the anthers, and when the stigma is beyond the place at which it would be found.

But all becomes clear if the function is to enable insects to carry pollen from one flower to another.

If—a short time after the flower has opened, when the anther-cells have burst, when the anther-tube has opened slightly at the top, when the mouth of the anther-tube is turned downwards, and when the style is growing and is pushing the stigma and its brush towards the mouth of the anther-tube—any pointed object is thrust into the tube, it touches and rubs and pushes a little backwards the stiff bristles attached to the connective of the lower anthers. This motion, combined with the thrust of the style and of its brush, forces the pollen through the small opening of the anther-tube downwards in a gentle stream or shower on the back or upper side of the object inserted. A pencil will become covered for some length by it. The aperture or slit in the tube of the corolla affords free play to the anther-tube under this treatment.

Bees frequent this lobelia, and get well dusted on the back

with the pollen. When an insect leaves one flower and goes to another, possibly a flower lower in position and in a later stage of development, on another stem or plant, he will very likely find the stigma of that flower expanded and protruded. If so, it will just sweep his back dusted with the pollen of the previous flower; and if he then mounts to a flower higher in position and in an earlier stage of development on the second stem or plant, he will probably find the anthers in a state to give up their pollen to him, and so on.

The flowers are very commonly out two at once on one stem, the lower one with the stigma protruded and unfolded, and the upper one with the stigma still within the anther-tube, and the anther-tube ready to discharge its pollen at a touch. The number of flowers visited by a humble-bee in a few minutes is very remarkable.

It is interesting to watch the gradations of this curious structure in *Campanula*, *Jasione*, and *Lobelia*. All have the stamens set upon the calyx; all have the brush on the style for sweeping out the anthers; in all the stigmatic surface remains closed until the pollen has been swept out; and in all, when the stigma opens it turns its back on its own pollen, if, indeed, any is then left on the style. But there are great differences.

In *Campanula* the brush is long and the three-lobed stigma large; the pressure of the growing style with its brush against the anthers is effected by means of the edges of the lobes of the valvate corolla, which are folded deeply inwards, and, being opposite to the stamens, press against their backs as the flower opens; and the transportation of pollen must be effected by the moving about of the insect within the bell and against the pollen-covered style. There must be a profuse expenditure of pollen; but even here there seems to be a wonderful economy in the bristles, which are not scattered on the style promiscuously, but are set on in ten rows apparently opposite the ten anther-cells.

In *Jasione* the brush is shorter, and the two-lobed stigmatic surface quite small; the long thin lobes of the corolla do not press the anthers against the brush, but, instead, the anthers in the opened flower are syngenesious. Their attachment to one another, however, is slight, is at the base only, and does not exist in the early bud. The transport of pollen must be effected by the insect walking over the numerous flower-heads, and amongst and against the long protruding styles, of which some in each head are generally pollen-covered, with closed stigmas, and others pollen-stripped, with opened stigmas.

In *Lobelia* the anthers are short, the brush on the style is

reduced to a ring of bristles, and the stigma is also small; but by the remarkable arrangements above noticed in the hard and completely syngenesious anthers (syngenesious from an early stage in the bud) and in the style, the pollen is ejected in small quantities at a time on the exact spot in the insect on which it should be placed for transportation to the stigma of another flower, and is swept with equal precision from that spot by the stigma of the next flower he visits.

XXXI.—*Note on a new Japanese Coral* (Isis Gregorii), *and on* Hyalonema. By Dr. J. E. Gray, F.R.S. &c.

Mr. Bradley Gregory, the Surgeon of H.M.S. 'Rattler,' has sent to Mr. Carruthers, for the British Museum, a fragment of a coral which appears to be new to science. Mr. Gregory observes:—"The man who was sent to procure specimens of the *Hyalonema* from Inosima brought back in addition a large branch of what at first appeared like the plant that grows in the marshes, called *Equisetum*; but on close inspection it was found solid and smooth like glass, with joints and secondary branches coming from it. The gentleman who was kind enough to show me this thing tore off a small branch, which I have sent to you lashed on to a piece of bamboo."

The specimen sent indicates a new species of *Isidinæ*. The branch is very long, slender, of nearly equal thickness almost throughout the whole of its length, only very slightly and gradually tapering just at the tip. It is formed of about fifty or fifty-one elongated slender joints united by a short but distinct pale brown articulation. The joints are very similar in length, being rather more than half an inch long; but sometimes there is a shorter one interjected in various parts of the series. The branch is about 27 inches long, and $\frac{1}{8}$ inch in diameter; the horny internodes are very much shorter than the joint, and about the same diameter.

Unfortunately the specimen does not show what was the general distribution of the branches. This may be verticillate, as Mr. Gregory compares the coral to an *Equisetum*; and the elongated branches are like the slender ones of some of the species of that genus. The specimen does not afford any means of determining if the branches arise from the calcareous joints, or from the horny internodes of the stem, which distinguishes the two genera *Isis* and *Mopsea*.

Waiting the receipt of more perfect specimens, I propose to call the coral, provisionally, *Isis Gregorii*, after the gentleman who so liberally sent it to the British Museum.

Mr. Gregory sent with this coral a very interesting specimen of *Hyalonema Sieboldii*. It is attached to a sponge which shows on the surface the numerous circular and oblong (this form being perhaps produced by compressing the open mouths) oscula, surrounded by a slightly raised edge, which are figured in Professor Schultze's plate. The presence of these oscules shows that the prominences in the bark cannot be "the oscule" as Dr. Bowerbank supposes.

The coil is very short, very thick, and formed of a large number of short spicules. These spicules, though short, are complete; for they taper at the tip, and exhibit the usual appearance of perfect spicules; otherwise it might have been supposed that this was only the base of a longer coil. The coil is a full inch in circumference at the base, and spread out towards the end. It has unfortunately been entirely deprived of its bark, except just where it emerges from the sponge, where there is a narrow imperfect ring of the bark, with small-sized circular prominences, being the contracted polypes, which are raised considerably above the surface, and have a small central impression. The coil is about 8 inches long; but one or two of the spicules are nearly one inch longer.

Every specimen that I see of this production more and more confirms my first idea that the coil and bark constitute a coral which is connected with a parasitic sponge.

XXXII.—*On a new Free Form of* Hyalonema Sieboldii, *and its manner of growth.* By Dr. J. E. Gray, F.R.S., V.P.Z.S., F.L.S.

Mr. W. Cutter has most kindly sent to me for examination a series of seventeen specimens of *Hyalonema Sieboldii*, which he had just received from Japan. They are all in good condition, better than most specimens when they arrive. The bark in all but one is decidedly in its natural state; this, on the other hand, certainly has been entirely stripped of its bark, and fresh bark recently stripped from some other specimen has been artificially put on to it; it would almost appear as if the coil of two specimens had been twisted together into one.

The series shows two very distinct varieties—one the kind hitherto known, which is found affixed to a sponge, and the other a free form of the coral, which is covered with bark to the very base of the coil. Of the sixteen specimens in their natural state, nine belong to the first, and six to the latter or free variety.

The attached variety is generally of a larger size and greater diameter; but they are known, even when the sponge is absent, by the basal portion sunk in the sponge being conical and tapering to a fine point formed of the very slender ends of the spicules. Six specimens of this variety have the sponge attached to the coils. The sponges vary considerably in size; but they are all more or less oblong, and most of them show more or less distinctly, according to the care that has been taken of them when they were collected and packed, the circular oscule, with its prominent edge, that is well represented in Professor Schultze's plate in his essay on the coral. The three other specimens have the naked conical base of the coil, and have, no doubt, been separated from the sponge when they were collected.

The six specimens of the free variety are all rather smaller and more slender than the majority of the other specimens; they have the lower half of the coil covered with bark to the base. The coil in these specimens does not suddenly taper to a fine point, as in the specimens that are taken out of sponges, but is only a very little smaller in the diameter of the base than in the middle length of the specimen. The bark of these specimens has never been removed, the tubercles or papillæ being regularly disposed and of a nearly uniform size; and there are generally two, and sometimes three, papillæ or animals quite at the end, which is more or less truncated, and in the dried specimens sometimes bent up or recurved.

There can be no mistake as to the end of the coil that is covered with the bark*; for it is easy to determine the different

* I am aware that Dr. Bowerbank states that M. Bocage has mistaken the upper part of the Portuguese specimen for the lower; but this is only a proof of the very cursory and incomplete manner in which he examined the Portuguese specimens in the British Museum; for any one who is acquainted with the structure and organization of the spicules of *Hyalonema* cannot possibly mistake one end of them for the other. The statement is as inaccurate as his assertion that the bark, the papillæ, and the animal of the Portuguese and Japan specimens are alike, or his declaration that the papillæ or contracted animals are oscules, and have no tentacles nor cnidia, in defiance of the observations of Brandt, Schultze, and Bocage, as well as myself. It is rather a difficult matter attempting to discuss a scientific question with Dr. Bowerbank. For example, when I say "*Hyalonema* [meaning the coil] has no sponge-structure," he replies, "Brandt, Schultze, &c., have proved that *Hyalonema* [meaning the sponge to which the coil is attached] has sponge-structure," which I never denied (P. Z. S. 1867, p. 905). When I said, "silica is not exclusively secreted by sponges, as the advocates of the sponge theory seem to believe," he replied, "no one ever asserted that silica is exclusively secreted by sponges;" yet a little lower down in the same page (P. Z. S. 1867, p. 904) he argues that the spicules of *Hyalonema* must have been secreted by sponges, as silica is only secreted by the *Protozoa*—that is, sponges.

ends of the separate spicule, and, from the same character, equally if not more easy to determine the ends of the coil of spicules. The spicules of *Hyalonema* are elongate, unequally fusiform: that is to say, thicker in the middle portion and tapering at each end; but the lower tapering part of the spicules is much the longest, and it tapers to a much more slender and finer point—the end above the thickest part tapering very gradually and being truncated before it reaches to a slender point. The consequence is that the coil is always much thicker in the upper part, from the greater thickness of the spicules, than in the lower one.

Since I have seen these specimens, I have a strong belief that the *Hyalonema Sieboldii*, fig. 1. pl. 1 of Brandt's 'Symbolæ,' and most probably of *Hyalochæta Possieti*, t. 2. f. 6, are free corals, with the basal end covered with bark; but he did not so regard them. I may also observe that the spicules figured (t. 2. f. 12 & 13) are represented on the plate with what he calls the upper part or free end of the spicule towards the bottom of the plate.

The specimens of this variety are exactly like the free specimens that M. Bocage found on the Portuguese coast; and they show that both the Japanese and the Portuguese species are sometimes found free, without any sponge at the base, and at others growing from a mass of sponge; and it has been lately observed that sometimes even two corals will grow from the same sponge.

I think this goes far to show that the attachment of the coral to the sponge is not a necessity, but only a frequent habit, and to prove that the coil of spicules is not a development of the spicules of the sponge to which it is attached. If this were the case, the sponge, which would be so important to its development, would always be present; for if the coil is the development of the spicules of the sponge in which it lives, how are the spicules developed when there is no sponge at the base to develop them?

The coil itself cannot be a sponge, as it is destitute of sarcode, inhalant pores, and excurrent oscules—the distinctive characters of sponges.

On the other hand, if we regard the spicules as the secretion of the animal that invests them, all these difficulties disappear; and every part of the structure leads to this conclusion.

This series of specimens is very instructive; and I have been able to secure a part of them for the British-Museum Collection, so that they may be examined by any one interested in the controversy.

First, all the specimens, like all the others received from

Japan, have the tubercle or papilla formed by the contracted animal cylindrical, prominent, and truncated, and very unlike the slightly raised elongated oblong papilla of the contracted animal of the Portuguese specimens of *Hyalonema lusitanicum*; and the bark of all of them is covered with a sand-like coat, very different from the smooth bark of those which inhabit the Atlantic Ocean.

Secondly, it is interesting as showing that the Japanese species, like the Portuguese one, sometimes lives free, and has the base of the coil entirely covered with animals, some of them being situated on the very extremity of the base. Indeed, from the number of specimens of this form that have been brought home in this collection, it may be as common as those that live in sponges; but, not being of such a large size, the latter may be preferred both by the collectors and the persons who purchase them and bring them over to this country.

In the collection there are two anomalous specimens. One of them differs from all the other specimens of both varieties in the coil being much more slender, formed of a comparatively small number of spicules, and very much longer than any of them. The coil is about 24 inches long, and scarcely half an inch in circumference. The bark that remains on the coil is thinner than usual, but is studded with regular, equal-sized, normal-shaped papillæ, but of a smaller size than in the other specimens.

The other specimen has been evidently manipulated by the Japanese; and though the base is covered with papillæ, it is clear that the coil (or, rather, the two united coils of which it appears to be formed) belongs to corals that were attached to a sponge. This coil is very thick, and formed of very numerous spicules; the lower half and the conically attenuated base is covered with short strips of bark that have been artificially applied round it when the bark was in a fresh or moist state; the papillæ on the bark, being probably taken from more than one specimen, are of very unequal sizes, and, from manipulation, of irregular form. The eggs of two sharks have also been artificially attached to this specimen.

Specimens which have been thus artificially doctored are easily known from those that are covered with the proper bark of the coil. In the latter the papillæ or contracted animals have a regular arrangement and a uniform shape and size; while the tubercles or papillæ of the bark that has been artificially applied are irregularly arranged and generally more or less distorted by the manipulation.

P.S. I have no doubt there has been a considerable importation of specimens of *Hyalonema*. Mr. Cutter has sent me

twenty additional specimens, which he has just purchased, to examine. Twelve of them are imbedded in larger and smaller fragments of sponge; and the coils vary greatly in diameter and length, and in the quantity of bark on them. Two belong to the free variety; one is not in a good state: the other confirms me in the opinion that the *Hyalochæta Possieti*, figured by Brandt, is a free variety; for it nearly resembles this figure; but the polypes are not quite so long nor quite so much clustered.

When examining these specimens I was induced to re-study the whole question and to re-read Professor Max Schultze's well-reasoned and very interesting paper on the genus in the 'Annals & Mag. Nat. Hist.' for March 1867 (xix. p. 153), and made the following notes, feeling satisfied that Prof. Schultze, like myself, is only desirous of arriving at the truth as to the structure of this most interesting marine production, and that we chiefly differ from observing the specimens in different states and from a different point of view.

I think that Prof. Max Schultze overestimates the similarity of the *Palythoa* on the *Axinella* and the animal of *Hyalonema*. The *Axinella* is not "*always covered* with this parasite;" the animals are scattered singly or in groups on the surface of the sponge, forming irregular tubercles, which caused Esper to call the sponge *Spongia tuberculata*. I cannot consider it "the most perfect analogy to the parasitism of *Palythoa fatua* in *Hyalonema*;" there the polypes form a uniform continuous bark, the inner coat of which surrounds each of the siliceous spicules with a sheath of corium. (See Brandt, t. 4. f. 14.)

There can be no doubt that the idea of our *Hyalonema* being a sponge arose in MM. Valenciennes and Milne-Edwards's minds from the examination of very imperfect specimens; for the latter states that "the polypes, which we have observed in a dry state *on different parts of the axis*, appear to be only parasites belonging to the order Zoantharia." One of the three figured in Prof. Schultze's work is destitute of any bark; and the other two only have very small quantities of the bark on the coil near the sponge. Well-preserved specimens generally have about half the length of the coil covered with animals. They seem more abundant in England than on the Continent. I have had through my hands, since I first described the genus in 1835, between 300 and 400 specimens.

Dr. Max Schultze observes:—"Thus, therefore, we have every imaginable proof of the mutual relation of the 'Glass Rope' and the sponge, which may be briefly recapitulated as follows:—

"1. The long siliceous threads are in structure indubitable sponge-spicules. They must therefore have been produced in a sponge." [I have shown that in structure and function they are unlike any sponge-spicules known. See Ann. & Mag. Nat. Hist. 1868, i. p. 292.]

"2. Such a sponge, likewise with siliceous spicules, occurs constantly at the lower extremity of the 'Glass Rope,' in organic connexion therewith." [Bocage and I have shown that many most perfect specimens of *H. Sieboldii* and *H. lusitanicum* are found that never had any sponge connected with them (see species figured, Brandt, t. 1. f. 1; t. 2. f. 6), though Dr. Max Müller regards the sponge as something *permanently constant*.]

"3. The sponge at the lower extremity of the long threads has very characteristically constructed spicules, inasmuch as their axial canal always possesses one or two perpendicular transverse canals. The same characteristic structure is also displayed by the longer and shorter threads of the 'Glass Rope.'" [This character is common to the spicules of many sponges, and may be common to these and the spicules of *Hyalonema*, which, as stated above, differ from the spicules of all known sponges in the structure of the end and in their mode of growth and function. The reason why I did not refer to this point in my former paper is that I did not, and even now do not, regard it as so important as Prof. Schultze seems to consider it. The existence of a transverse canal being common to siliceous spicules of a sponge and of *Hyalonema* did not appear to me to decide that the latter were not secreted by a polype. The value of microscopic observations depends on the accuracy and knowledge of the observer; and we must not decide beforehand that a siliceous spicule with a transverse canal cannot be secreted by a polype because we have not before observed one, especially when the spicule has other characters that separate it from all sponge-spicules, as is the case with the long spicule of the coil of the *Hyalonema*.]

I have been often told that Prof. Schultze has shown a series of spicules gradually passing from the form in the sponge to that in the coil. I cannot find any one showing any passage from one to the other, nor the slightest approach to one with the ring of spines, or the peculiar appearance of the end or fracture. There is a considerable difference in form between the cruciform spicules of the sponge at the base and that on the bark—so great as to have induced Brandt to call one *Spongia spinicrux* and the other *Spongia octancyra*; yet probably the sponge on the bark is only an extension of the sponge at the base, like the sponge found between the ends of

the spicules of the top of the coil. Sponges permeate and overrun everything in their neighbourhood.

Prof. Max Schultze observes that no one who has opened the sponge and examined the extremely fine ends of the long siliceous threads in the axis of the sponge "can doubt that the most intimate organic union exists between the porous sponge and the 'Glass Rope,' and that both, therefore, form an organic whole." (Ann. & Mag. Nat. Hist. 1867, xix. p. 155.) If Prof. Schultze means that some particles of the sponge extend themselves up between the spicules of the coil, that is, no doubt, true; but as we all know that sponges will extend themselves up between all kinds of structure, I cannot regard that as any proof of organic union. And I suspect that this is what he does intend when he refers to the examination of imperfect specimens which had been removed from the sponges (p. 155); and he seems not to have seen any specimen that never had a sponge attached to it (though such are now known to exist), and erroneously suspects that M. Bocage's specimen, which is now in the British Museum, was imperfect.

It is curious that neither Prof. Schultze, Dr. Bowerbank, nor any of the advocates of the spicules being developed from the sponge has ever attempted to show how the spicules are developed by the sponge, whence they originate, or to show any connexion between the individual sponge-spicules and the spicules of the coil, or that there is any connexion between the pores and tubes of the sponge and the coil. As far as I have seen, the coil under the bark is a solid body composed of many closely packed spicules united together by fibrous corium like the lower surface of the bark, and which surrounds each and at the same time unites all the spicules into a mass destitute of any pores or canals; and the end of the coil in the sponge, in the four or five specimens that were cut open for the purpose of examination, has always been separated from the cavernous part of the sponge by a thick, very hard, compact coat formed of felted spicules. As this coat and the cavernous structure of the sponge are not represented in Schultze's t. 2. f. 1, I suspect it is rather a diagram than a representation of a specimen.

Prof. Max Schultze states, "As yet only *lime* salts are known in the skeletons of polypes." (Ann. & Mag. Nat. Hist. 1867, xix. p. 154.) And Dr. Bowerbank observes, "I believe that the animal power of organizing siliceous matter to form either an internal or an external skeleton will be found to be strictly confined to the great subkingdom of the Protozoa." (Proc. Zool. Soc. 1867, p. 904.)

These authors have overlooked the analysis of coral quoted

from Dana, in which it is shown that as much as 23 per cent. of silica is found in the Madrepores; and silica is also found in the axis of *Gorgonia* and other corals, forming an essential part of their organic structure. (P. Z. S. 1867, p. 120.)

Prof. Lovén, who adopts Prof. Schultze's theory, that the sponge is an integral part of the organism, when describing a true sponge from the North Sea which he regarded as a *Hyalonema*, came to this conclusion from the study of the form and structure of the Japan sponge as described by Prof. Schultze, which had been overlooked or not properly appreciated by Prof. Schultze himself and other zoologists, myself among the number, which, I think, fully prove that the sponge is not affixed to marine bodies and placed at the base, but at the apex of the glassy coil, the base of which he believes to be affixed to some marine body, regarding the siliceous coil, as seen in museum specimens, as only a fragment that has been accidentally broken from its other fixed part. This latter notion is inconsistent with what we know of the habits of the genus, and also with the structure of the spicules of the different specimens, which always taper towards the end in a most uniform and regular manner, very unlike an accidental break of a coil of spicules produced by an external force.

Dr. Lovén says that the circular holes on the outer surface of the sponge (the chimneys or *oscula* of Prof. Schultze) "cannot be the pores for the exterior current." But I think that if he had been able to examine the sponge he would have found that they are connected with the *oscula* in the internal cavities of the sponge. (See Lovén, Ann. & Mag. N. H. 1868, ii. pp. 81, 89.)

It was difficult to understand how what are here called the "free" *Hyalonemata* keep themselves erect on the sea-bottom; for it is clear they must do so, as the similar size and development of the polypes show that they must be all equally within the reach of food. (See P. Z. S. 1867, pp. 119, 902.) The direction and manner in which the polypes on the apex are developed shows that this cylindrical coral must be permanently erect.

It is quite possible that the *Hyalonemata* live with the siliceous filaments sunk in the sand; and that might explain why we have never seen, even in the most perfect and well-developed specimens, the coil of siliceous spicules covered with the polypes and the bark-like crust for more than half its length, and that always on the upper part of the coil.

A dealer, more than two years ago, showed me a number of coils in the state in which he received them from Japan, in which the exposed filaments of the coil were covered with

mud; and he said that the collector told him that they lived with part of the coil sunk in the mud. I did not credit the account then, but I see reason to do so now.

I believe that it will be found that the coral grows erect, with the part of the coil not covered with animals sunk in the mud, like the Sea-pen or *Pennatula* (the siliceous spicules, not being liable to disintegrate or change in structure, are well adapted for such a mode of life in their uncovered state), and that the sponge when present is a parasite that grows at the apex, and not, as has hitherto been considered, at the base of the coil of the coral.

If this theory is the true one, as I believe it to be, the family and genera may be thus characterized:—

Hyalonemadæ.

Social zoanthoid polypes, secreting a central siliceous internal axial coil for their support. The upper half of the coil covered by a uniform cylindrical bark regularly studded with retractile polypes. The polypes are developed at the apex and are directed upwards as the coral grows; those on the bark near the naked part of the spicules are degenerate or less developed than those on the other part of the bark; they appear to die off below as the lower part of the coil sinks deeper in the sand.

The axis consists of numerous siliceous threads or spicules extending from end to end and coiled together into a cylindrical rope-like form.

The spicules, as far as they are covered with the bark-like polypes, are each surrounded and separated from each other by a thin sheath of corium, the whole forming a dense cylindrical coil enclosed by the external bark formed of the united polypes.

The part not covered with the bark consists of the lower half of the same spicules, which are separate and distinct from each other, forming a beautiful tuft of glassy filaments.

Each spicule is formed of a great number of concentric coats with a central canal, like the spicules of sponges; but the ends of the spicules are unfinished and truncate, showing the laminæ of which they are formed, the inner laminæ projecting beyond the others, and the outer being the shortest. (Brandt, t. 2. f. 12, 13, 15; Schultze, t. 2. f. 3, 4, 5.)

The spicules are linear-elongate, subcylindrical, unequally fusiform, tapering at each end, the end that is enclosed under the bark being the longest and most slender*. (Brandt, t. 2. f. 12, 13, 14, 15.) The surface is smooth, but near each end

* The fractured or imperfect ends, the concentric ridges and spines on the surface, and the spicules being surrounded with *corium* at once

there are concentric ridges edged with a series of spines that are directed towards the middle of the length of the spicule. (Schultze, t. 2. f. 4, 5). These spicules are lengthened as the coral grows.

The corals live erect at the bottom of the sea, with the free part of the spicules sunk in the mud or sand.

The upper part of the coral is often taken possession of by a cup-shaped parasitic sponge (*Carteria*). The sponge destroys the polypes; and the ends of the spicules form a short rapidly tapering cone, which is separated from the sponge by a number of spicules felted together, forming a hard case which separates the end of the coil from the rest of the sponge.

The coils of spicules, as left when the polypes die and the bark has rotted or been eaten away by fishes, &c., are often found in the sea, as are also the separate spicules.

M. Bocage makes a statement that is otherwise difficult to understand. He says, "I have several specimens of *Hyalonema* with other parasites: two are covered with an Antipatharian, three absolutely destitute of polypes and sponges, one embraced by the foot of an *Actinia* of what seems to me a new species." (Ann. & Mag. Nat. Hist. ser. 4. vol. ii. p. 37.) Dr. Semper has lately named a single specimen of *Hyalonema* he received from the Philippines *H. Schultzei*, because it is destitute of polypes and bark, but attached to a sponge.

They have been found in a fossil state in Mountain Limestone, retaining the siliceous character of the coil.

HYALONEMA, Gray, Proc. Zool. Soc. 1835, p. 64; Ann. & Mag. Nat. Hist. 1850, vi. p. 306; P. Z. S. 1867, p. 118 (not Lovén, Ann. & Mag. N. H. 1868, p. 90); Brandt, Symbol. 14 (1859); Wyville Thomson, Intell. Observ. 1867, p. 81.

Hyalochæta, Brandt, Bull. Acad. Pétersb. 1857, p. 17; Symbol. 17 (1859).

Bark sandy. Polypes cylindrical when contracted. Tentacles 20.

1. *Hyalonema Sieboldii*, Gray, P. Z. S. 1835, p. 65, &c. B.M.

H. mirabilis, Gray, P. Z. S. 1857, p. 279; Bowerbank, P. Z. S. 1867, p. 18; Lovén, Ann. & Mag. N. H. 1868, p. 90.

Type, without parasitic sponge on apex:—

H. Sieboldii, Brandt, Symbol. t. 1. f. 1; Wyville Thomson, Intell. Observ. 1867, p. 93, f. 1.

Var. *Possieti*. Polypes produced and clustered.

Hyalochæta Possieti, Brandt, Symbol. t. 2. f. 6–20.

separate the siliceous spicules of zoanthoid polypes from the spicules of sponges.

A. With parasitic sponge on apex.

H. Sieboldii, Gray, Brandt, Symb. t. 1. f. 4, 5; Schultze, Hyalonemen, t. 1, t. 2. f. 1, 2.
H. mirabile, Bowerb. P. Z. S. 1867, t. 4. f. 3.

B. Without the sponge, but with the part of the coil deprived of polypes where it had been.

H. Sieboldii, Brandt, Symbol. t. 1. f. 2, 3, 6, 7, t. 2. f. 2.

Hab. Japan.

In examining some thirty-seven specimens which have lately arrived in London from the same locality in Japan, I find the contracted animals vary considerably in form and size. They are generally nearly uniform in size and distance from each other in the same specimen. In one with small close polypes I found a small oblong cluster of some twenty or twenty-five polypes, rather smaller than the others, all crowded together into a mass.

Some three or four specimens had the contracted animals considerably larger and further apart, not quite regularly circular in shape; but they are very different from the contracted animals of *H. lusitanicum*.

One specimen without any sponge had the polypes very irregularly dispersed—some far apart, others very close, and even clustered together forming irregular prominences. This specimen is somewhat like *Hyalochæta Possieti* (Brandt, Symbol. ii. t. 2. f. 6); but the polypes are not quite so long and prominent as in that figure. The study of these specimens and others I have seen induces me to believe that there is only a single rather variable species found in Japan.

Unfortunately all the sponges on Japan *Hyalonemata* I have been able to examine have been in a bad state, with an eroded surface, as if they had been worn by the sea; and that is probably the condition of the ones figured by Schultze, though the oscules are represented as complete; but the surface of the sponge, judging from the sunken part of some of the specimens in the complete state, is covered with a close-grained dermal layer. They have generally been crushed in packing or drying; some exhibit circular perforations on the surface. They vary greatly in shape, some being large and oblong, others contracted, ovate-elongate, like Brandt's t. 1. f. 4, 5. I believe these forms arise from their being squeezed when taken out of the sea, or after being washed. There are three specimens in the British Museum, one only anything like perfect, which, ovate-elongate before it was soaked in water, is conical cup-shaped, with a large conical cavity reaching

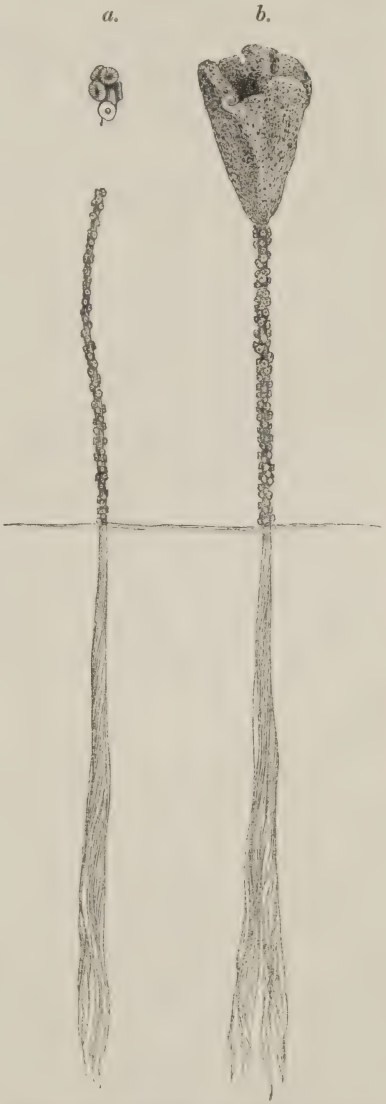
nearly to the apex of the coil. The cavity is partly filled up with irregular contorted plates of different sizes, projecting from the wall of the cavity. The parietes are thin; the upper edge of the cavity is thin, sinuous, and not showing any indication of having been attached to any marine body. The apex of the coil is sunk in one side of the wall of the large cup-like sponge.

The second specimen is somewhat like the former; but the upper part of the wall is broken away, the parietes are thickened, and there are three unequal conical concavities, the middle one much deeper than the rest.

The third specimen is much more imperfect. It is a square spongy mass, which has been crushed and disintegrated; it has only a moderate-sized central conical concavity; but a great part of the cup is wanting.

As far as I have seen, all the sponges are more or less cup-shaped, with a central conical open cavity.

2. *Hyalonema Schultzei* is probably a distinct species, as it came from the Philippines; but it is described probably from a dead specimen of a coil that had lost its bark and animals.



Hyalonema Sieboldii, growing in the mud, reduced to $\frac{1}{4}$ the natural size. *a.* the contracted polypes on the apex, larger; *b.* the parasitic sponge on the apex.

HYALOTHRIX, Gray, P. Z. S. 1867, p. 119.

Bark smooth. Polypes oblong when contracted, low. Tentacles 40.

Hyalothrix lusitanica, Gray, *l. c.* 1867, p. 119. B.M.

Type *Hyalonema lusitanicum*, Bocage, P. Z. S. 1864, p. 265, t. 22; 1865, p. 662; Gray, Ann. & Mag. Nat. Hist. 1866, xvii. p. 287; Lovén, Ann. & Mag. N. H. 1868, p. 90.

Var. *spongifera*.

H. lusitanicum, Bocage, Ann. & Mag. Nat. Hist. 1868, ii. p. 36; Bowerbank, P. Z. S. 1867, p. 902.

Hab. Portugal.

P.S. Dr. Perceval Wright, who has just returned from dredging for *Hyalonemata* on the coast of Portugal, informs me (Sept. 14) that he believes the coral (*H. lusitanicum*) grows at the bottom of the sea in deep water, with the free part of the coil sunk in the sand. He also mentioned to me that M. Bocage has some specimens of the sponge that grows on the *H. lusitanicum* with a shallow cavity that is covered with a netted lid formed of spicules, like the lid of *Euplectella*. I do not find any trace of such a lid in the three sponges on the *Hyalonema Sieboldii* in the British Museum; but it seems to exist in some specimens of that sponge, as Dr. Lovén says that Prof. Schultze found "the flattened surface of the smaller and younger specimen (No. 4) covered by a network of spicules similar to that which covers the free end of *Euplectella*." (Ann. & Mag. N. H. 1868, ii. p. 89.)

XXXIII.—*On the Boring of certain Annelids.*

By W. C. M'INTOSH, M.D., F.L.S.*

[Plates XVIII., XIX., XX.]

AT the Meeting of the British Association held at Dundee, my friend Mr. E. Ray Lankester read a very interesting paper on "Lithodomous Annelids," or, rather, on the boring of *Sabella saxicava*, Quatref., and *Leucodore ciliata*, Johnst., chiefly with reference to the latter. In the discussion which followed, Mr. Gwyn Jeffreys and I strongly opposed the theory advocated by the author as to the action of a purely chemical agency in the production of the perforations. I specially mentioned that *Leucodore ciliata* bores in aluminous shale—a fact fatal to the chemical (or acid) theory—and am

* Communicated by the Author, having been read at the Meeting of the British Association at Norwich, Aug. 24, 1868.

now compelled to make a few remarks on the subject at this stage, on account of the publication of the above-mentioned paper in the 'Annals of Natural History' for April of this year (1868). In the latter publication the author states that "Dr. M'Intosh was the only observer at Dundee who expressed a belief that these Annelids perforate rocks other than carbonate of lime. He said he had seen aluminous shale so bored; but I think he had other excavations in mind, such as Annelids will make in the semisolid silt filling cracks in shale, or else that he has since seen reason to change his opinion; for he has not produced any such specimen of shale, although then challenged to do so. I submit that the opinion as to aluminous shale, unsupported by any chemical test or specimen, and confessedly only casually noticed, should not be of any weight in the balance against the facts as to the exclusive erosion of limestone which are above recorded." I had for the time forgotten the subject till I saw this paper (and for the first time its challenge) in the 'Annals;' yet, on referring to my notes on *Leucodore ciliata*, made several years ago, I find that it bores not only in aluminous shale, but in a material, in a chemical sense, even more impenetrable.

Boring and burrowing are very common features in the British Annelida. The majority are fitted chiefly for perforating sand or sandy mud, such as the *Lumbrici*, *Nephthys*, *Nerine*, *Cirratulus*, *Nereis*, *Eteone*, *Glycera*, *Arenicola*, *Scalibregma*, *Ammotrypane*, *Ophelia*, *Travisia*, *Aricia*, *Terebella*, *Sabella*, *Mœa*, and others; and the modes in which they pursue this their daily occupation vary greatly. *Glycera* and *Nephthys* especially disappear with rapidity amongst the sand by boring with their proboscides, the former passing its elongated organ through a considerable space in a single thrust. *Eteone* dashes through the water in ever-varying screw-coils, and carries its snout with equal facility through sand; and the motions of *Ammotrypane aulogaster* are even more vigorous, especially as regards penetration of the latter. The efforts, again, of *Scalibregma*, *Ophelia limacina*, *Travisia*, and *Mœa* are less violent; but they easily penetrate the same semisolid medium. Some, such as *Nereis pelagica* and *Dumerilii*, occasionally occupy galleries in the stems of softened *Laminariæ*; while *Hediste* (*Nereis*) *diversicolor* bores in vast numbers in the peat of Perrelle Bay, in Guernsey, and more sparingly in casual pieces of the same material on the eastern shores of North Uist. Several delight to bore in muddy clay, such as *Eunice*, *Lumbrinereis*, and *Notocirrus*. Many species occur in galleries between the layers of shale and sandstone, and in the cracks of granite, gneiss, and other rocks, amidst sandy mud,

as well as elsewhere, such as several of the *Spionidæ*, *Eunice*, *Lysidice*, *Trophonia*, *Syllis armillaris*, *Psamathe fusca*, *Castalia punctata*, *Eulalia*, *Thelepus* (*Venusia*), and *Aphlebina*. Of these, *Lysidice* is often found under the calcareous spreading base of *Corallina officinalis* along with *Leucodore*, under the large littoral Ascidians at Herm, and in masses of *Cellepora* from the deep water off St. Martin's Point, Guernsey, and, though it would seem to take possession of an old tunnel, yet appears capable of accommodating the hole to its own wants. Lastly, a few Annelids bore rocks, stones, and shells of various kinds, amongst which are *Leucodore*, *Dodecaceria*, *Sabella saxicava*, *Heterocirrus saxicola*, Grube* (a species I cannot at present distinguish from *Dodecaceria concharum*), besides some of the adjoining group, Gephyrea.

There is no more common Annelid along the rocky parts of the beach at St. Andrew's than *Leucodore ciliata* (Pl. XVIII. fig. 1); and, indeed, it is a very abundant British form in general. It especially haunts the soft blue shale at the West and Castle Rocks of the ancient city, apparently, like its companion *Pholas crispata*, because it finds such more easily excavated than the denser sandstone, just as we see it avoiding the hard granite and gneiss of the Channel Islands and the outer Hebrides, and tunnelling its galleries under the spreading base of *Corallina* and the numerous Nullipores, both free and surmounted by the tangles, or as M. de Quatrefages† found at Guettary, in the case of *Sabella saxicava*, which preferred to bore the calcareous rocks rather than the quartz with which they alternated. It is likewise abundant in the fissures of the shale and sandstone, forming tunnels amidst the muddy débris so abundant in these localities, where Dr. Johnston seems alone to have found it. Œrsted, again, gives "sandy tubes" as its sole habitation. Vast numbers of the common limpet-shells are also invaded by them, their tracks with the loop at the bottom being visible from the inner surface as whitish streaks; and the irritation frequently causes the mollusk to secrete layer upon layer of the nacreous lining. It abounds likewise in many other littoral and deep-water shells, such as *Buccinum*, *Fusus*, *Haliotis*, *Ostrea*, and *Anomia*, and, indeed, in favourable sites, almost upon every shell thick enough to bore into.

Its presence amidst the shale and sandstone is easily recognized by numerous small tubes, composed of agglutinated sand and mud (Pl. XIX. fig. 1), which project from the surface of the stone in dense groups, so as to form in many cases a kind of sward of tubes—a habit apparently characteristic of the

* Archiv für Naturges. 1855, p. 108, Taf. 4. f. 11.

† Ann. des Sc. Nat. sér. 3. Zool. tome viii. 1847.

race in all parts of the world; for the Abbé Dicquemare long ago noticed this on the coast of France, and in more recent times M. Schmarda* describes and figures a species (*Leucodore socialis*) having a similar habit, on the coast of Chili, Mr. Alex. Agassiz another on the shores of the United States, M. de Quatrefages at Boulogne, M. Claparède at Skye, and Dr. S. Wright in the Frith of Forth. Mr. Lankester, however, does not allude to this habit; and such tubes are certainly rare on the calcareous rocks. Very short ones are occasionally observed on the surface of *Corallina*. These tubes are composed, according to the nature of the site, of minute grains of sand and mud, or pure sand, cemented together by a tough secretion, which likewise gives a smooth coating to their interior. They project sometimes nearly half an inch from the stone or other material; and, when laid along the surface, in some cases they exceed this in length. If the animals are scattered, it will readily be observed that each is supplied with two independent and occasionally divergent tubes, which thus correspond to the double nature of their perforations in the stone. Both are formed in the same way, the Annelid reversing itself in its gallery at will and augmenting the length of the quiescent tube: thus the restless tentacles are observed to project now from the one and now from the other. The animal displays great energy in proceeding with its work, its tentacles resembling a struggling *Ascaris* that has been seized by the middle and is endeavouring to make its escape. Not only are these organs thrown about in all directions, but each undergoes a series of vermiform wrigglings, no head meanwhile being visible from the aperture of the tube. After lashing the water for some time, they may be noticed moving along the surface of the stone with a serpentine motion like independent worms, and seizing any convenient particle of mud, sand, or food they may encounter. Upon effecting this, the tentacle is not contracted as in the Hydrozoa and Actinozoa, but its vermiform motions along the rocky surface remain unaltered, while the particle is observed to wend its way towards the mouth of the tube along the tentacle in a remarkable manner, to be seized by the lips of the animal. Baster† distinctly noticed this quality in the tentacles of *Leucodore*, mentioning that, however unwilling, the prey was dragged by the organs into the tube and consumed at leisure. Hence he inferred they had many of the properties pertaining to the tentacles of polypes. The fact also did not escape the notice of that most patient and keen observer of nature, Sir J. Dalyell, in "*Spio seticornis*;" for he says, "The particles that may be selected for the edifices are

* Neue wirb. Thiere, 1. ii. p. 64, tab. 26. figs. 209 & 209 *a*.

† Basteri Opuscula Subseciva, tom. ii. lib. 3. p. 135.

seized and passed along the tentaculum, and apparently carried to the mouth*". If the particle of sand, for instance, after entering the mouth of the tube, is considered suitable, it is by-and-by pushed out with the snout, and arranged on the circumference of the tube with the glutinous secretion. Occasionally the proximity of other tubes affords an opportunity for abstracting particles therefrom, as well as causes frequent collisions with neighbouring tentacula, especially apparent when two take possession of the same prey. Now and then a small mass of mud and sand may be seen travelling outwards from the tube along the tentacle, to be dropped at some distance. Quantities of débris, again, may sometimes be observed issuing from both apertures; and in those vessels in which the animals have been vigorously at work on new sites, heaps of minute grains of sand or altered shale are grouped on the flat surface around the tubes; or if these are elevated in the vessel and project horizontally, the débris falls to the bottom or clouds the side of the glass. Where the basis material is bluish shale, this débris has a brownish colour, and the particles assume a somewhat definite ovoid shape, so that the heaps have a peculiar miliary appearance. The alteration in the colour in this case is interesting, showing that in all probability the masses have passed through the digestive tract of the Annelid. Moreover we may be fairly warranted, from the appearances, in assuming that at least some of the constituents of such heaps are the results of the boring, and not all due to the seizure of external particles from (in this case) the smooth surface of the shale. There was nothing peculiar in the instance of the sandstone, whose loose débris after boring resembled the grains of sand removed from the mass.

The benefits of a tube superadded to the gallery in the stone are apparent; for the tentacles are thus enabled to take a longer sweep through the surrounding water for the capture of minute structures while the delicate body remains protected. Moreover a field of competition is opened up to these social Annelids, in which it must at least occasionally occur that the best and most rapid builder of these tubes is placed under more favourable conditions for existence than those with shorter tubes or those confined to the dead level of the rock or shell.

When the animal happens to find a large mass of loose material near its tubes, it sometimes protrudes its head and anterior region, and aids the tentacles in dragging it towards the mouth of the tube, or occasionally the anterior part of the body is extruded in an exploratory manner; but, as a rule, they are very shy. A free animal is now and then encountered, and, if in perfect health,

* Power of the Creator &c. vol. ii. p. 159.

it is not the helpless animal described by Dr. Johnston*, but progresses very actively indeed, either on a horizontal or perpendicular surface; and if circumstances are unfavourable for its gaining the stone, or, if it so chooses, it fashions a tube round its body with ease and rapidity (provided materials are forthcoming), either on the bottom or along the side of the vessel. Nor is it satisfied with the construction of one home, but roams about from place to place and forms several. In such instances the tube is not generally turned on itself, but is more or less linear, the cup of the anal segment communicating freely with the water by the open end of the tube. They are also not unfrequently found swimming on the surface of the water, like other Annelids.

The first point that strikes the observer in regard to the perforations in the sandstone and shale is that they are grouped in pairs, sometimes with a thicker and sometimes with a thinner intervening column. In many cases this column would seem to be formed of débris; but in others, especially those in shell, sandstone, and *Corallina*, some of the original material is left; so that, by this feature, the observer is seldom left in doubt as to the identity of any particular gallery he encounters. From the exterior the tubes, as usually observed, proceed inwards either as nearly straight or more or less curved cylindrical galleries, and terminate in the case of each pair by joining in a loop at the bottom, the latter being either abruptly or gently curved, according to the thickness of the intervening column. This siphonal form of gallery is very general among the Annelida and other burrowing animals; various *Terebellæ*, *Eunice sanguinea*, *Cirratulus cirratus*, and others follow this habit in the fissures of rocks; while *Corophium longicorne*, so abundant in company with *Edwardsia* on some of our muddy or clayey shores, has its burrow of the same characteristic formation. In *Leucodore*, as a rule, the intervening column attains the largest dimensions inferiorly, a considerable wedge of sound shale being often left at the loop. The latter, moreover, in some was marked by two or three grooves, showing that at various times the animal had altered the depth of its galleries to suit its convenience, perhaps in relation to the length of its built-up or external tube, though this is not a matter of much consequence. All the tubes were lined by the delicate secretion before mentioned.

In the borings in shell, Nullipore, and *Corallina* the tube or perforation had not, in our specimens, the form of a keyhole, as mentioned by Mr. Lankester, but possessed a solid column of the original structure, or else one of consolidated débris, intervening between the tunnels. In the sea-worn specimens of

* Catalogue of Worms, Brit. Mus. p. 206.

chalk and limestone, the empty perforations, however, do exhibit a form somewhat like a keyhole in transverse section; but in the calcareous rocks and stones containing living specimens the double tube is completed by an intervening column of débris, except at the loop. In not a few of the worn pieces of chalk and limestone, only the widened inferior end or junction of the tube remains. This is a point of some interest, since *Dodecaceria concharum* abounds in the same sites, and its gallery is distinguished in transverse section by having no incurvation, or only a very slight incurvation in the middle, and is not double; yet the dried remains of this worm might most aptly be described "as a black carbonaceous film," whereas the dried remnants of *Leucodore* are of a pale or straw-yellow hue.

Amongst the minute fragments of flint which form the fine gravel of Luccomb Chine, in the Isle of Wight, are many loose rounded pieces of limestone and chalk more or less perforated by *Leucodore* and *Dodecaceria*; but the living examples of the former occur chiefly between half tide and low-water mark, the best site being at the verge of the latter, and this more especially as regards *Dodecaceria*. *Leucodore* is not only abundant in the substance of the rocks themselves, as mentioned by Mr. Lankester, but swarms under the spreading base of *Corallina*, though, on account of the inconspicuous nature of the apertures in the latter, little or no trace of the borings can be observed until the surface is split off. Besides, in this (littoral) region there are numerous flattened stones, one or two feet square, that have their surfaces quite worm-eaten by the perforations of the Annelids, whose now vacant galleries have been considerably enlarged by the action of the sand and surf. Occasionally the borings in these large stones were arranged in a linear series, the worm having attacked the commencing fissures as the most vulnerable parts of the mass. At White-Cliff Bay, again, the perforations in the chalky rocks abounded in the same region, and were of a somewhat larger size than those made by our northern examples.

Descriptions of the general structure of *Leucodore* have been published by the Abbé Dicquemare, Dr. Johnston, MM. Œrsted, Grube, Claparède, and Keferstein; so that my remarks at present shall be confined to the tentacles, bristles, hooks, and anal segment.

The tentacles (Pl. XIX. figs. 1 & 2) are a pair of very mobile muscular organs, possessing in each case a ciliated furrow on the inner side, Dr. Johnston being in error in averring that the inferior side is so supplied. Dr. Strethill Wright* has given a somewhat minute account of their microscopic appearance in

* Edinb. New Phil. Journ. 1857, vol. vi. p. 90.

this species (in all probability), which he termed *Spio seticornis*. He observed that the tentacles, when seizing a fragment of oyster, attached themselves to it "not by winding themselves round it, but by simple adhesion, as if they were studded with numerous suckers and hooks, like the arms of the cuttle-fish." This prehensile apparatus "consists of numerous large papillæ thickly crowded together along the borders of the tentacles," each having an "acuminated soft cilium or spine." On forcibly pressing the tentacle, "the spine-bearing papillæ burst, and there issues from each of them a.... pear-shaped capsule (trichocyst).... which, again, on rupture, discharges a multitude of acicular spicules." He likewise states that the tentacles are furnished with "a ciliated band running from the tip to the base," but does not point out the actual disposition thereof. In his drawing of the tentacle (fig. 18) the papillæ are ranged along each side of the organ from base to apex.

When the tentacle is extended, as in its ordinary motions (Pl. XIX. fig. 1), there is little or no appearance of wrinkles. A very considerable alteration, however, ensues on placing the animal, even without irritating pressure, between glasses, and certainly much more so if the tentacle itself is removed by violence. The ciliated groove along the inner border, like the rest of the organ, is minutely granular, especially towards the tip, the latter, on the slightest contraction, assuming a minutely warty aspect (fig. 2). Besides the long cilia which cover the furrow, there are various motionless hairs along the opposite or exterior border of the organ, as indicated by Prof. Keferstein, and which are also present on various other parts of the animal. The wrinkling of the tentacles in most views is very marked, the whole organ being crossed by transverse seams, between every two of which a series of very distinct temporary papillæ occur at the edge, which papillæ sometimes do possess a motionless cilium or "spine," and are more likely to do so under paralyzing pressure; but the appearance shown by Dr. Wright is the result of injury, and not a natural interpretation of their anatomy, however closely his outline may indicate what he saw. These temporary papillæ, in common with the entire surface of the furrow, certainly present a streaked appearance; but such is due to the compressed cilia; and I have never been able to see the remarkable "trichocysts" and their acicular contents as described by this ingenious naturalist, to whose observations I gave due respect by repeated examinations. Circular cells filled with minute granules often escaped through the delicate epiderm of the pressed organ, together with minute granules and swarms of discarded cilia; but there was no

trace of the "trichocysts." M. de Quatrefages*, again, in his remarks on the respiration of the Annelids, refers to a drawing of the tentacle of a *Polydora*, which may or may not be this species. He shows the ciliated region to be cellular, but does not notice crenations.

On the tentacles of several were the curious parasitic forms represented in Pl. XIX. fig. 3. They were attached by a short stalk, and, when set free, moved rapidly through the water by the aid of their cilia, which in their fixed condition were next the tentacle.

The fifth body-segment of the worm has the characteristic strong hooks (Pl. XVIII. fig. 2), which are accompanied by the peculiar bristles with spear-shaped heads (fig. 3), besides the minute dorsal fascicle of the ordinary structure. The tip of each of the first series is strongly curved; and towards the concave side thereof a spur projects, apparently with a twist backwards and ventrally; and hence, if the organs are separated and pressed between glasses, this spur in not a few cases almost escapes observation: this is especially the case in spirit preparations. In the larger southern examples the spur is less visible than in the smaller, as the hook under pressure assumes a position which hides the projection; it is very evident, however, when the hook is viewed *in situ*. The shaft of the hook in the large examples is marked at intervals by transverse striæ. Mr. Lankester's figures† may be taken as the representatives of altered bristles from specimens in which they have been subjected to some morbid influence, either due to the nature of the habitat (calcareous rock) or otherwise. Other specimens from the same rock show the ordinary structure with the single spur beneath the tip. In some of the altered specimens the spear-shaped bristles accompanying the hooks are absent. Mr. Alex. Agassiz has given a better view of their structure, though he does not refer to the spear-shaped bristles which accompany them. In the majority of the specimens from St. Andrew's three of the hooks were well developed, the first being the longest, and the fifth and sixth rudimentary but nevertheless showing the secondary fang or spur even more distinctly than the others. In larger examples from Cobo Bay, Guernsey, and the southern shores of England, these hooks are more numerous‡.

* Ann. des Sc. Nat. sér. 3. Zool. tome xiv. pl. 5. fig. 10.

† Ann. Nat. Hist. ser. 4. vol. i. 1868, pl. 11. fig. 9.

‡ At the late meeting of the British Association, Mr. Lankester, while at once admitting the erroneous condition of his own published drawing of the hooks, denied the accuracy of mine as exhibited in a large coloured drawing accurately copied from the two figures (Pl. XVIII. figs. 2 *a*, *b*) ac-

The inferior appendages of the rest of the body-segments consist of characteristic hooks—organs, I may add, that have received but scant justice from their artists, with the exception of M. Claparède* and Mr. Agassiz, though the latter appears to have slightly misapprehended their true nature, as he speaks of "a stiff bristle extending from the base of the curve"—which can only refer to the wing of the structure, about to be described. The figure† of this careful observer, though earlier, is more correct than Mr. Lankester's. When the hook is pressed flatly between glasses (Pl. XVIII. fig. 4 *a*), the crown shows a long tooth in front, with a shorter superior process and a distinct wing; but the latter, of course, has been altered by pressure, as, when viewed under favourable circumstances (fig. 4 *b*), it has a wing on each side of the crown and upper part of the shaft. Dr. Thomas Williams was in error when he assigned a dorsal position to these hooks‡. The bristles throughout conform to one type (fig. 5), having a long shaft, somewhat abruptly bent and tapered at the tip, which has a narrow process or wing on each side.

The anal segment is furnished with a peculiar cup (fig. 6), whose margin does not form a continuous ring, but is inflected and slit in the middle of the dorsal surface. A few minute and motionless cilia are placed round the margin. The papilla of the anal orifice is richly ciliated. The organ does not impress the observer as being eminently adapted for adhering to surfaces, after the manner of a sucker; nor have I been so fortunate as to see the animal using it for this purpose. Mr. A. Agassiz and MM. Claparède and De Quatrefages, however, have seen the Annelid employing it for such; and M. Mecznikoff§ is another author who mentions that a "sucking-disk" is met with in *Leucodore*. Dr. Williams, again, remarks that the anal segment is expanded with geometrical exactitude into a hollow cone, which acts on the principle of the sucker, the worm "letting down its weight on the part, in order to press

companying this paper. He said that, instead of one spur, there were several spurs beneath the curved tip. Of course I have found no reason to alter an opinion formed after an examination of specimens from the north, east, and west of Scotland, from the north-east, south, and south-west of England, and from the Channel Islands. Mr. Agassiz and Prof. Keferstein, moreover, show only one process; and though M. de Quatrefages represents at least two beneath the tip of the hook of his *Leucodore nasuta* from Bréhat, I am bound to add that many of this distinguished author's drawings are not scientifically accurate. I do not know on what authority my friend made his statement; and it is to be hoped he will clear up the mystery.

* Archiv für Anat. u. Phys. 1861, Taf. 13.

† Ann. Nat. Hist. ser. 3. vol. xix. pl. 6. fig. 38.

‡ Report Brit. Assoc. 1851, p. 208.

§ Zeitschr. für wiss. Zool. Bd. xvi.

out the water with which the bottom of the tube may be filled;" and thus the Annelid "amid the raging billows is securely anchored to its cell." From the siphonal nature of the tube, this description cannot apply in any degree.

Another very common borer in shells, nullipore, and calcareous rock is *Dodecaceria concharum*, Œrst., a Cirratulean which has a larger tube, shaped something like a keyhole in transverse section, and terminating in a slightly dilated, smooth, cæcal extremity. This animal likewise lives in the fissures of the rocks in the Channel Islands, forming in the mud long galleries bent in various ways, but always readily distinguishable from those of *Leucodore*. In addition to the foregoing localities, a specimen was sent me alive from St. Andrews rocks in its characteristic tube in sandstone. In this instance the perforation in the stone was lined by a considerable coating of carbonate of lime, so that it had a smooth whitish aspect—as if the animal had not relished constant contact with the rough grains of sand, and had fashioned a coating analogous to the well-known secretion of *Teredo*. Even in the spreading base of *Corallina officinalis*, the gallery inhabited by this animal is often so smooth, and its appearance on fracture so characteristic, that the observer is led to suspect the existence of some secretion which covers over the roughnesses of the tube and the rocky surface. The bristles (Pl. XX. fig. 4) in this species have a dilated and flattened tip with a finely serrated edge, and taper to a fine point. The shape of the hooks (figs. 2 & 3) is peculiar and characteristic, and enables the observer to distinguish the dried remnants at once. The animal tinges the spirit of a rich dark-green hue, just as Sark specimens of its ally *Cirratulus cirratus* do, but gives no acid reaction to test-paper. The *Nereis sextentaculata* of Delle Chiaje*, which lives in holes in the rocks of the Neapolitan shores, is, in all probability, referable to the same species: and the *Narganseta corallii* of Leidy† is likewise either the same or a very closely allied form. The latter bores dead portions of *Astrangea astræformis*.

A third British borer is *Sabella saxicava*, Quatref., which, according to Messrs. Stewart and Lankester, is found in the limestones near Plymouth; and I have found it abundantly in Oyster, *Pecten*, *Anomia*, and other dead and living shells dredged off the Channel Islands, as well as perforating the *Balani* that cover the sides of the Gouliot caves at Sark, near

* Memorie sulla Storia e Notomia degli Animali senza Vertebre del Regno di Napoli, vol. iii. p. 176, tab. 43. fig. 16.

† "Marine Invert. of Rhode Island and New Jersey," Journ. Acad. Nat. Sc. Philad. ser. 2. vol. iii.

low-water mark, my attention having been first directed to the latter site by Dr. Bowerbank, who kindly sent me dried specimens. In these caves the tube of the Annelid is often coiled in its groove beneath the *Balani*, and then pierces the shell of the latter to appear on the upper surface. It likewise bores abundantly in *Cellepora pumicosa*, and in one instance had bored quite through the valve of a living *Pecten pusio*. It often occurs in the same oyster-shell in a combined attack with *Gastrochæna dubia*, *Leucodore*, and boring sponges, or sometimes places its tubes in groups in convenient fissures of the shell without boring, so that they can be dislodged *en masse* like short and contorted tubes of *Tubularia indivisa*. Another site is under empty limpet-shells amongst muddy débris, part of each tube being inserted into a perforation in the shell; while, again, the cracks and fissures of the rocks near low-water mark afford a very favourite habitat in the Channel Islands, and their tubes are often seen projecting through incrusting sponges and Ascidians, both simple and compound. The species has a tough horny tube, whose exposed portion is furnished with minute grains of sand; but the immersed portion is hyaline and more delicate. The boring in the shell and limestone is circular, and, though often more or less curved or coiled, it is not to be confounded with the work of *Dodecaceria* or *Leucodore*. I need not allude further at present to the structure of the species, save to observe that its branchiæ are speckled with pale green and white, and furnished with two or three brown pigment-specks exteriorly, and that its hooks (Pl. XX. figs. 5 & 6) (which are accompanied by broadly spear-tipped minute bristles, fig. 7) and bristles (fig. 8) have the structure represented. The body shows a distinct acid reaction towards the posterior end, and especially at the tip of the tail.

The fourth native borer is a little *Sipunculus*, which externally appears to be identical with *S. Johnstoni* of Forbes. It occurs in limestone on the shores of the Isle of Wight, bores into the spreading base of *Corallina* with the foregoing forms in the Channel Islands, tunnels the mud in the fissures of various rocks, and one occurred in a shell sent by Mr. Gwyn Jeffreys in his rich Zetlandic collection of 1867. The form of the perforation in the latter case is club-shaped; and a young specimen had bored its tiny gallery from the tube of its parent —a very rare occurrence amongst the true Annelids. In this instance the tubes of *Campanularia verticillata* had taken possession of several of these minute galleries after the death or exit of the original inhabitant. This boring *Sipunculus* is quite neutral to test-paper.

Annelidan borings have been noticed by many observers. In 1765 Baster* describes and figures the very species (*Leucodore ciliata*), I have no doubt, which has just been brought forward by Mr. Lankester. He observes, "Alteram *Nereidis* speciem, quam hic describo, voco *minimam tentaculis longissimis*;" and his next sentence shows that he had at least as extensive an acquaintance with its habitat as some very recent writers:—"Hæc in lapidibus, ostreis, aliisque piscibus testaceis, qui e limoso maris fundo petuntur, reperitur quam frequentissime, habitans semper in parvo ex limo aut arena constructo tubulo." This author, although he does not further allude to the habitations in the stones, mentions that he put a quantity of sand beside them in a glass vessel, and that they very soon bored into this, and constructed tubes at the entrance of their tunnels. The Abbé Dicquemare† in 1781 also refers to the same species, and he gives figures of the animal which, however inaccurate, may at least bear comparison with some of very modern date. He called it a sea-insect, and he cites it as an influential agent in destroying the calcareous rocks and stones in the neighbourhood of Havre. In a second paper by the same author ‡, what appears to be a *Sabellaria* is described, which, it is stated, prolongs its tail within the rock or stone, as well as fashions a tube of coarse sand or fine gravel outside. He advanced the idea of a solvent to account for these borings, an explanation all the more likely, as his specimens of rocks bored by marine "insects" were all calcareous. Dr. P. C. Abildgaard § gives fair descriptions and figures of two species which bore into the marble cliffs and calcareous stones below water at Santa Cruz in the West Indies. He calls the one *Terebella bicornis*, and the other *Terebella stellata*. The first is a *Cymospira* (*C. bicornis*) characterized by having a hard, horny, flattish operculum, from which project two branched antler-shaped processes. He also mentions at the end of his paper that another was sent him with three horns on its operculum, the third being closely appressed to the plate; but the animal was otherwise similar to the first. The latter is thus closely related to the *Cymospira tricornis* of Dr. Baird ||, who remarks that it had apparently burrowed in Madrepore—a habit characteristic of other species of the genus, whose galleries occasionally pierce

* Basteri Opuscula Subseciva, tom. ii. lib. iii. p. 134, tab. xii. fig. ii. A, C.

† Observat. et Mém. Phys. tom. xviii. 1781.

‡ *Op. cit.* tom. xx. 1782.

§ Schrift. Gesellsch. ntrf. Freund. Berlin, i. 1789, pp. 138–144. I am indebted to Dr. Albert Günther for a copy of this paper, he having sent a complete translation, instead of a mere abstract in the original (German).

|| Journ. Linn. Soc. vol. viii. 1865, p. 17.

the fractured blocks in all directions. The second species of stone-borer (*T. stellata* = *Pomatostegus stellatus*, Mörch, Schmarda, &c.) described by Dr. Abildgaard has an operculum composed of three flats or plates raised one above another, and supported by a central column or axis, and likewise has been found perforating coral reefs. Mr. Osler * alludes to the abundance of worm-perforations (when treating on the same subject) in the Mollusca, thus—"The boring Annelids are innumerable in calcareous rocks, and are found to attack every marine shell almost as soon as it has acquired sufficient thickness to afford them a nidus;" and he further instances the cases of the *Nereides*, *Arenicola piscatorum*, and *Terebella conchilega*, as well as that of the *Spatangi* burying themselves in sand. His figure of *T. conchilega*, however, very much resembles *T. littoralis*. Mr. Templeton † fairly describes the perforations of a species, which is probably *L. ciliata*, in the limestone rocks of Whitehead, Belfast Lough, and figures the perforated stone and the animal in various positions. Mr. Garner ‡ refers to the subject in the Zoological Transactions, thus, "Certain Annelides apparently possess the power of excavating. The rocks on our coast are pierced by a minute worm, probably of the genus *Diplotis* of Montagu; it is strongly ciliated, but its mouth does not appear adapted for making its way into such hard substances." His figure is doubtless intended to represent *Leucodore*; but only two eyes are shown, and there is no structural distinction made at the fifth segment of the body. In the same Transactions, Mr. R. Templeton § mentions a borer in the corals of the Isle of France called *Anisomelus luteus*, which has numerous long, hollow, prehensile tentacles, that seize prey like Sapajous' tails. It forms for itself a minute tube on the surface, as well as bores into the coral. M. Œrsted ‖ next describes the boring of *Dodecaceria concharum* in shells. M. de Quatrefages ¶ details the perforations of *Sabella saxicava*, and points out the interest which such would have to the geologist; for though a *Helix* might perforate limestone like the marine lithophagous mollusca, and thus render its pristine site ambiguous, there could be no doubt about the ancient condition of stones bored by this *Sabella*. In his recent work he refers more than once to the subject**. Dr. Williams†† observed the boring habit of *Leu-*

* Phil. Trans. 1826, p. 342.
† Loudon's Mag. Nat. Hist. ix. 1836, p. 234.
‡ Zool. Trans. vol. ii. p. 95.
§ Zool. Trans. vol. ii. p. 27, tab. v. figs. 9–14.
‖ Annulat. Danic. Consp. p. 44, 1843.
¶ Ann. des Soc. Nat. sér. 3, Zool. tom. viii. 1847.
** Hist. Nat. des Annelés, vol. i. pp. 129 and 133; vol. ii. pp. 295, 415, 437, 552, 583, 597. †† Report Brit. Assoc. 1851, p. 208.

codore ciliata, but did not enter into the *modus operandi*. M. Marcel de Serres * describes the genus *Stoa*, one of the chief characteristics of which is that it perforates West-Indian shells —a fact, however, which had previously been observed by other naturalists. M. Valenciennes †, in his remarks on the perforating *Echini*, instances the case of a *Sipunculus* that bores wood. M. Lacaze-Duthiers ‡ describes, in a careful paper, *Bonellia viridis*, a Gephyrean which bores calcareous rocks on the shores of Corsica. Prof. Grube § has lately described two other forms beside that first mentioned, viz. *Sabella saxicola* and *Phascolosoma verrucosum*, which perforate the limestones of Martinsica and the island of Lussin in the Adriatic.

The chemical theory in regard to such borings, it is well known, has frequently been brought forward by zoologists in the instances of Mollusca and Sponges, and lately has even been assumed with regard to the Bryozoa ‖. Moreover it has more than once been promulgated to explain the means whereby Annelids perforate shells and rocks. Besides those already alluded to, Mr. Osler, for instance, brings forward the case of the Annelids to show that a shell is not essential to the boring-process, and in support of the solvent theory; yet he could not find any such agent in the animals. Like his successor Mr. Lankester, he gets over the "argillaceous" difficulty by averring that they do not bore in this material, but, more fertile in resources, he hints that they probably inhabit cavities bored by other animals ¶. A. S. Œrsted considered that *Dodecaceria concharum* bored partly by aid of the secretion of its alimentary canal (which, says he, contains muriatic acid), and partly by aid of its hooks. Sir J. Dalyell ** likewise thought that the tube of this animal might be enlarged by some solvent. Mr. Spence Bate †† accounts for the majority of marine borings by an ingenious theory which adroitly shifts the onus of the solvent from the animal itself to its surroundings; or, in other words, he avers that the solution of the difficulty and the rock is achieved by the agency of *free carbonic acid held in solution by sea-water*. He instances "the groove sunk by the *Spiroglyphus*, which Annelide affords a good example to illustrate the theory; for it not only sinks a groove in the shell on which it has erected its own, but, should its contortions bring it into contact with any portion of its own

* Ann. des Sc. Nat. sér. 4. tom. iv. 1855, p. 230, pl. 8 c. figs. 1–8.
† Compt. Rend. Acad. Sc. Paris, tom. lxi. 1855.
‡ Ann. des Sc. Nat. sér. 4, Zool. tom. x. p. 49, pls. 1–4.
§ Ein Ausflug nach Triest und dem Quarnero, pp. 47, 48, 1861; and Die Insel Lussin u. ihre Meeresfauna, 1864.
‖ Ann. Nat. Hist. ser. 3. vol. xvii. p. 472.
¶ Phil. Trans. 1826. ** Pow. Creat. vol. ii. p. 210.
†† Transact. Brit. Assoc. 1849, p. 73–75.

shell, it absorbs it equally with any other." It will be observed that in the last clause he anticipates and answers one of Mr. Lankester's recent queries*. It may also be remarked in passing, that it is probable that the genus (*Spiroglyphus*) here referred to is the same as the *Stoa* of M. Marcel de Serres, as hinted by Mr. Shuttleworth in the same vol. of the 'Ann. des Sc. Nat.'

This chemical or solvent theory has been shown by many authorities to be inadequate to explain all the facts connected with the boring of the Mollusca; for, besides the boring of wood by the *Teredo*, some of the *Pholades* perforate gneiss, mica-schist, talc, peat, resin, and sandstone, as well as calcareous rocks; and I would only refer to the careful digest and observations on the subject in the 'British Mollusca' of Messrs. Forbes and Hanley, and to the experienced and recent remarks of Mr. Gwyn Jeffreys†. M. Valenciennes is of the same opinion with regard to the *Echini*. Indeed MM. Cailliaud ‡ and Fischer §, in describing the borings of *E. lividus*, show that it excavates (notwithstanding the adverse opinion of Mr. Trevelyan ||) not only calcareous rocks, but gneiss, granite, whitestone (leptynite), schist, &c., while foreign species invade basalt: and the former author, in his first plate, represents several specimens of *Echinus lividus*, of the natural size, located in their holes in granite from Croisic, on the coast of France. Dr. Bowerbank ¶ likewise, in his careful and conscientious observations on the boring question, gives no support to such a theory; and Mr. Hancock ** could find no trace of acid in his specimens of *Cliona*. M. de Quatrefages adds his weight into the scale against the idea of a solvent in the Annelidan perforations. Lastly, although Mr. Lankester appends the following sentence to his letter in the 'Annals' for July last, "It is almost impossible to assign any but a chemical means of excavation to *Bonellia*," it may be remarked that M. Lacaze-Duthiers, in the original paper, appears to be more cautious than to attribute its work to such an agency.

Physiologically it cannot be considered that carbonic acid in

* Ann. Nat. Hist. ser. 4. vol. i. p. 237, line 9 from bottom.

† Brit. Mollusca, vol. i. Introd. p. xxvii, and vol. iii. p. 94.

‡ Catalogue des Rad., des Annél., des Cirrhip. et des Mollusques Marins &c. dans le Départ. de la Loire Inférieure: Nantes, 1865.

§ Ann. des Sci. Nat. Zool. sér. 5. tom. i. 1864, p. 321.

|| This gentleman considered that the animal (*E. lividus*) possessed neither chemical nor mechanical power of perforating rocks, but that such excavations were produced by countless generations of such creatures, which thus, after the lapse of ages, gradually had worn the stone away. (Edinb. Phil. Journ. vol. xlvi. 1849, p. 386.)

¶ British Spongiadæ, vol. i. p. 221.

** Ann. Nat. Hist. ser. 2. vol. iii. p. 329.

a free state, and in such a quantity as to act on calcareous rock or shell, is a likely accompaniment to such an animal as *Leucodore* working in a tube, whatever may be the case with the salivary glands of *Dolium*, *Tritonium*, *Aplysia*, and the acid secretion of *Gastrochæna* and other Mollusca. Annelids are very sensitive to irritants and narcotics, and must be judged by the same rules in this respect as the majority of other animals. And this statement is not impugned by the fact that a few, such as *Cirratulus*, may occasionally be found burrowing in odoriferous mud, like the ubiquitous crustacean *Carcinus mænas*. It therefore appears to me to be just as prudent and useful to bring forward the chemical theory in regard to the perforations of *Limnoria* and *Chelura terebrans* in wood, of the *Pholas crispata* in the hard shale and sandstone in company with *Leucodore* at St. Andrews, in regard to the deep cavities made by *Patella vulgata* in the latter rock on the same sites, in regard to the borings of the *Echini* and the wide interlacing channels of *Hymeniacidon* in shells and stones on all our shores, as to produce it for the explanation of Annelidan perforations. Yet Mr. Lankester prefaced his observations on the boring of *Leucodore* by the statement that he was prepared to find such due to chemical action, because an acid reaction was found in *Sabella saxicava**. We are thus prepared for the following remark:—"Supposing, then, the agency in *Leucodore* to be a chemical one, has any acid been observed? It has: specimens of *Leucodore*, placed on litmus-paper, give a strong acid reaction." I have carefully tested for acidity in numerous specimens of *Leucodore* from St. Andrews; but not a trace thereof rewarded my attempts, though an ambiguous stain is occasionally produced by old sea-water in which they and other Annelids have been confined. No acid reaction at all was visible; and to apply the epithet "strong" to such a case would certainly be after the fashion of a chemistry unknown to us. Moreover I asked a distinguished young chemist, Dr. Crum Brown, to repeat the tests. He wrote me as follows:—"I found exactly as you have stated on the labels, viz. that *Cephalothrix filiformis* has a marked acid reaction in every part of its body, and that *Leucodore ciliata* is quite neutral. The perforated and grooved stone is not calcareous, and is scarcely attacked by acids: prolonged action of tolerably strong hydrochloric acid dissolves a little iron.... It appears to be a kind of mica schist." I was not more suc-

* I am glad to say that Mr. Lankester has since seen reason to change his opinion. While maintaining the correctness of his statement with regard to the acidity of *Leucodore*, he withdrew his chemical theory after the reading of my paper at the Meeting of the British Association.

cessful in finding acid traces in the southern examples. For a considerable time I have been familiar with an acid reaction in the cutaneous textures of many Nemerteans, such as *Borlasia olivacea*, *B. octoculata*, *B. lactea*, *Lineus longissimus*, *Stylus purpureus*, *Cephalothrix filiformis*, *Ommatoplea alba*, *O. melanocephala*, *O. gracilis*, &c.; indeed acidity seems characteristic of the group, the only exceptions as yet observed being in the deeply tinted *O. purpurea* and in *O. pulchra*, which have an alkaline reaction, rendering red litmus-paper blue. One of the most vivid red streaks is caused by the common *Cephalothrix filiformis*, referred to above. Some species of *Chone*, again, which do not bore, likewise give an acid stain to litmus-paper. The mere presence of acidity, therefore, is no proof whatever that an animal bores. None of the Nemerteans, for instance, do so, their habitats being in muddy sand under stones between tide-marks, in fissures of rocks, or in the cavities of old shells and stones from deep water. It is well to bear in mind also that *Dodecaceria concharum* and *Sipunculus*, both very common borers, show no acid reaction when tested with litmus-paper.

While thus shutting out the chemical means of boring from being the law to be applied universally to the perforations made by Annelids, I should deem it rash at present, on my part, to promulgate any new theory, or to support any of the old.

Mr. Lankester concludes his paper with some remarks on "the specific title and distinction of the lithodomous *Leucodore*." "The boring species," he says, "does not differ obviously from *Leucodore ciliata*. I have not been able to make a comparison of specimens; but it seems probable they differ only in habit." Yet he suggests the name of *L. calcarea* for the boring form. I cannot agree with the author here either; for I have never seen more than a single British species of *Leucodore*, which, however, bores in materials very varied in their composition. It is unsafe to suspect a form to vary specifically simply on the ground of its habitat; and assuredly some more weight would have been given to his view of this matter if he had founded the distinction on the abnormality of the hooks of the fifth segment of the body, or on the absence of the spear-tipped bristles which accompany them. The perusal of the remarks of M. de Quatrefages* on the different species of *Leucodore* is somewhat unsatisfactory; and it appears to me to be by no means certain that at least five of his species do not refer to one, or at most to two forms. It is further worthy of note that, so far as I am aware, no other observer (excluding the more than doubtful cases of M.

* Hist. Nat. des Annelés, vol. ii. p. 296 *et seq.*

Œrsted and Mr. Lankester) has clearly made out another European species; for I consider Leuckart's *Leucodore muticum** a somewhat inaccurately described *L. ciliatus*, Johnston. The possession of only two eyes, and the fact that the great hooks occur on the "sixth" segment of the body, and are three-toothed, characterize the *L. nasutus* of M. de Quatrefages. The author states that the anal segment terminates in a flattened cup, which permits the Annelid to attach itself to solid bodies; and his figure shows no split in the margin. If the latter arrangement is correct, then the previous characters may hold. It is also but fair to remark that specimens occur at St. Andrews with two eyes, and even with one only, and that the anterior pair in all, being on a lower level, are less easily seen from the dorsum than the posterior. The same may be said of *L. audax* and its circular cup. Moreover, as the latter assumes somewhat altered appearances in those whose tails are regenerating, some caution is needed in basing specific differences thereon. His *L. Fabricii* rests, as a species, upon characters that require further elucidation; and the remarks on *L. ciliata* are based on Dr. Johnston's description; and hence the author is misled as to the structure of the hooks of the sixth segment (fifth of the body), which really, as already mentioned, have a secondary spur or process. *L. dubia* is also founded on insufficient data. Lastly, there can be little doubt that the *Polydora cornuta* described by M. Claparède†, and given by M. de Quatrefages as the type of a new genus, is nothing more than *L. ciliata*. The want of scientific accuracy in the figures of the genus in the 'Annelés' renders identification difficult.

EXPLANATION OF THE PLATES.

Plate XVIII.

Fig. 1. *Leucodore ciliata*, Johnst.; enlarged under a lens.

Fig. 2. Great hooks of the fifth segment of the body: *a*, as usually seen in the separated and perfect organ under pressure; *b*, a more complete view, as obtained in the living animal or in a favourable spirit preparation. × 700 diameters.

Fig. 3. Spear-tipped bristles accompanying the former. × 700 diams.

Fig. 4. Hooks of the posterior region of the body: *a*, pressed between glasses; *b*, seen in front, so as to exhibit both wings. × 700 diams.

Fig. 5. Front and side view of two of the bristles of the same species. × 700 diams.

Fig. 6. Caudal segment and its cup. × 210 diams.

Plate XIX.

Fig. 1. Tubes erected by *Leucodore* at the apertures of its tunnel. The

* "Zur Kenntniss der Fauna von Island," Archiv für Naturges. 1849, p. 200, Taf. iii. fig. 12.

† Recherches Anat. sur les Annélides, Turb. &c. 1861, p. 47, et *op. cit.*

attenuated tentacles are seen protruding from the mouth of one. Enlarged under a lens.

Fig. 2. Tentacle of *Leucodore*, magnified. The organ is in the somewhat contracted condition in which it usually appears when the animal is placed between glasses: *a*, ciliated groove on the inner surface; *b*, cavity of tentacle; *c*, blood-vessel.

Fig. 3. Ciliated parasite attached to a fragment of the tentacle, *a*. × 700 diams.

PLATE XX.

Fig. 1. *Dodecaceria concharum*, Œrst., from a tangle-root, St. Andrews. Enlarged under a lens.

Fig. 2. Hook of the same species. × 350 diams.

Fig. 3. Extremities of two of the latter: *a*, of the same specimen; *b*, of a developing or somewhat imperfect specimen. × 700 diams.

Fig. 4. Bristles from a dried specimen in limestone from Torquay, sent by Dr. Bowerbank. × 350 diams.

Fig. 5. Posterior hook of a small *Sabella saxicava*, from a dried specimen in a *Balanus* sent by Dr. Bowerbank. × 700 diams.

Fig. 6. Thoracic hook of *S. saxicava*. × 350 diams.

Fig. 7. Minute spear-shaped bristles accompanying the latter. × 700 diams.

Fig. 8. Bristles of the same species: *a* & *b*, two of the forms met with in the thoracic region, the latter being viewed laterally; *c*, posterior bristle from the dried specimen referred to under fig. 5. × 350 diams.

XXXIV.—*On the Structure of the Shells of Brachiopoda.*

To the Editors of the Annals and Magazine of Natural History.

Oban, Sept. 21, 1868.

GENTLEMEN,

On my return from the mission of scientific research into the zoology of the deep sea, with the charge of which I have had the honour to be entrusted by the Admiralty, at the instance of the Council of the Royal Society (and the very remarkable results of which will be made public at the earliest possible period), I find the note of Prof. King contained in your last Number, on which I have only to remark that the admission he has cited of the fallacy of his original imputation upon the accuracy of my researches into the structure of the shells of Brachiopoda is limited to the single case of the recent *Rhynchonella psittacea*, which did not enter into his original charge, because he had not then examined it. That charge was founded upon his superficial examination of fossil *Rhynchonellida* and *Spiriferida*; and neither then nor since has Prof. King made the slightest retractation of it. By declining to reply to my last three questions, he leaves the matter exactly where it was before; so that it must be presumed that

he still holds to his original assertion as to the existence of perforations in these shells.

When Prof. King shall have shown the least ground for the belief that shell-tissue of the most peculiar and characteristic kind can be formed during the process of fossilization, so as to fill vacuities that existed in the recent shell (which is just as if, in the silicification of a piece of wood previously perforated by large holes, these holes should be filled up by true woody tissue), his assumption that the whole of Mr. Davidson's type specimen of *Spirifer cuspidatus* and that the imperforate spaces in the shells of *Syringothyris* were originally perforated may deserve consideration. Until then, I venture to think that the imperforateness of the former type, and the patchiness of the perforations in the latter, are established by Prof. King's confessed inability to set aside the facts stated by me on these points, as the direct results of careful and experienced observation.

Trusting that this is the last occasion on which I shall feel it necessary to address you on this subject,

I remain, Gentlemen,
Your obedient Servant,
WILLIAM B. CARPENTER.

XXXV.—*Description of a new Species of Thylacine* (Thylacinus breviceps). By GERARD KREFFT, Curator and Secretary of the Australian Museum, Sydney.

[Plate XVII.]

SKULL shorter ($6\frac{5}{8}$ inch.) than that of *T. cynocephalus* ($7\frac{1}{2}$ inch.); the palatal openings much reduced in size; occipital foramen larger than in the well-known species. The anterior part of the skull is not much compressed; and the sharp nick so prominent in all skulls of *T. cynocephalus*, between the second and third premolars, is wanting in the present species. The greatest difference exists in the teeth, which in the new species are very large, the most prominent being the second and third molars in both jaws. The canines are thicker, and form a shorter curve; the outer incisor of the upper series is also very much larger than the corresponding tooth in *T. cynocephalus*.

I enclose three photographs of the skulls of both animals* in different positions, both very perfect, and that of *T. cynocephalus* larger than that of the new species. The last molar in *T. breviceps* has been lost from both specimens (in possession of the Trustees of this Museum); but the sockets indicate

* We have given in the Plate the figures of the new species only.—ED.

a larger tooth, though, owing to the youth of the animal, it is not yet in the same position as the one shown in the skull of *T. cynocephalus*.

The existence of a second Thylacine has been known to old residents in Tasmania for years past, as they were in the habit of distinguishing the two kinds by the names of Greyhound- and Bulldog-Tiger. Mr. George Masters, Assistant Curator of the Australian Museum, has spent some nine months on the island; and being anxious to clear this matter up, he collected about twenty-six skulls, two of which belong to the Thylacine for which I now propose the name of *breviceps*.

I shall, on a future occasion, give you a fuller account of the excellent collection made by Mr. Masters.

Sydney, May 2, 1868.

XXXVI.—*Notice of two new Species of* Salamandra *from Central America.* By Dr. J. E. Gray, F.R.S. &c.

Mr. Osbert Salvin has lately sent to the British Museum a collection of animals in spirits, collected at Guatemala and Costa Rica. It contains two species of *Salamandra*, which appear not to have been previously entered in the catalogues.

Œdipus Salvinii.

Black; chin, throat, and underside of body and tail and limbs pale brown; back and upper surface of the tail for about two-thirds of its length opaque white, with irregular-shaped black spots, and connected in front with a streak on each side of the back and head, continued to the eyebrows. The black spots have a very narrow white margin. The head very short; nose blunt, short, rounded; nostrils lateral, below the most prominent part of the nose, with an indistinct pale spot under them to the edge of the upper lip. The toes very short, webbed to the tip. Tail cylindrical, tapering, almost as long as the body and head.

Hab. Guatemala (Osbert Salvin, Esq.). B.M.

Ophiobatrachus.

Body long, cylindrical; tail very long, cylindrical, rounded at the end. Head very small; mouth large; eyes rather large, lateral; nose blunt, ovate; tongue circular, peltate. Legs far apart, elongate, slender, weak; toes very short, subequal, 4/5, free. Skin smooth, closely and minutely black-dotted. Vent linear. Teeth minute in both jaws; palatine teeth in an arched line on each side of the internal nostrils.

This genus has many characters in common with the genus *Batrachoseps*; but it differs in the tail (which is twice as long as the body and head) being cylindrical and of the same diameter and subannulated appearance as the body and head, giving the whole animal the appearance of a *Cæcilia* or worm.

Ophiobatrachus vermicularis.

Black. Length of the body and head $2\frac{1}{8}$ inches, of the tail $4\frac{1}{4}$ inches.

Hab. Costa Rica (Osbert Salvin, Esq.). B.M.

XXXVII.—*Last Report on Dredging among the Shetland Isles.* By J. Gwyn Jeffreys, F.R.S.*

This was my seventh expedition to the northern extremity of our seas, and occupied the whole of the summer. It was not so successful as those in some previous years, owing to the stormy state of the weather. While my friends in England, Wales, Ireland, and Scotland were enjoying calm sunshine, our climate was exactly the reverse; and the persevering course of the wind (from north-west to south-west) prevented our doing much at sea. The North Sea is notoriously subject to broken weather, this being the point where the warm air induced by the Gulf Stream and westerly winds meets the cold air brought down by the arctic current. The fauna of the Shetland waters, however, is by no means exhausted. Every expedition has produced novelties, not only in the Mollusca, but in all other departments of marine zoology.

On the present occasion I obtained, at a depth of 120 fathoms, a living specimen and a larger dead one of a fine species of *Pleurotoma*, *P. carinata* of Bivona. It was originally described as a Calabrian fossil; and Searles Wood records a single specimen having been found in the Coralline and another in the Red Crag. Professor Sars and Mr. M'Andrew dredged a few specimens off the coasts of Norway; and the former gave some interesting particulars of the animal, which I have been able to confirm by my own observation. Although allied to *P. nivalis*, and found in the same locality, it has distinct eyes placed on rather prominent stalks or ommatophores, whereas *P. nivalis* has no eyes nor any trace of eye-stalks. On this account Sars proposed the generic name *Typhlomangelia* for the latter species; but it must be borne in mind that *Eulima stenostoma* is also eyeless, and yet is closely related to

* Communicated by the Author, having been read at the Norwich Meeting of the British Association, August 20, 1868.

its congeners and companions, all of which have very conspicuous eyes. It is a somewhat remarkable coincidence that the shell of *E. stenostoma* resembles a large *Achatina acicula* (a land mollusk), which is in the same category as regards these so-called organs of sight. The shells of *P. carinata* and *P. nivalis* are easily distinguishable.

Among the rarer and more noteworthy mollusks procured this year were the following:—

Montacuta tumidula. St. Magnus Bay and near Fetlar. Described by me from the Hebrides in the Reports of the Association for 1866.

M. donacina, S. Wood. A single valve from deep water in St. Magnus Bay. Another valve had been dredged by me at Falmouth in 1839. It is a rare Coralline Crag fossil. It nearest ally is *M. substriata.*

Utriculus globosus, Lovén. A small living specimen occurred again in St. Magnus Bay.

U. expansus, Jeffr. A few young specimens also in St. Magnus Bay.

Odostomia Warreni, Thompson. Never having seen this shell in a fresh and perfect state, I considered it (Brit. Conch. iv. p. 143) a variety of *O. obliqua.* But the discovery of live specimens in St. Magnus Bay and near Fetlar enables me to separate the two as distinct species. *O. Warreni* has a shorter spire and more swollen whorls than *O. obliqua*, the suture is deeper, the striæ are much stronger at the base of the shell, the whole surface is covered with most delicate and close-set microscopic spiral lines, and the umbilicus is well developed and deep. The animal of *O. Warreni* has a peculiar foot; this is not plain and rounded at its extremity, as in *O. obliqua*, but is deeply bilobed or forked like the tail of a swallow. No other species of *Odostomia*, so far as I am aware, has a similar foot. One individual spun a fine glutinous thread from the middle of the sole of the foot, and kept itself suspended for some time from the surface of the water, with the point of the shell downwards. I found a dead specimen of *O. obliqua* on the same ground with *O. Warreni.*

O. umbilicaris, Malm. A young specimen from St. Magnus Bay, nearly globular, and thus exhibiting the same distinctive characters as the adult.

Siphonodentalium Lofotense and *Cadulus* (or *Loxoporus*) *subfusiformis* again occurred, the former being more widely distributed. Both inhabit the Mediterranean; and the latter is a Sicilian and Viennese fossil. I had an excellent opportunity of observing them alive and in active motion. The thread-like and extensile organs by which the Solenoconchia seize their prey are unlike the tentacles of any Gastropod, and their

function is quite different. I would call these organs *captacula*, an appropriate word and not less classically formed than *tentacula*.

Leda pernula was again dredged in St. Magnus Bay; but with it was a dead and apparently semifossil valve of *Tellina calcarea*. I must therefore hesitate in considering the one more than the other recent or an inhabitant of the British seas at the present time.

Being in the south of Europe last winter I undertook the examination of the Mediterranean and Adriatic shells; and the result greatly surprised as well as interested me. The dredgings of Capt. Acton (the Commandant of the Italian navy) in the Gulf of Naples, and the extensive collections of Dr. Tiberi at Portici, General Stefanis at Naples, Herr Weinkauf from Algeria, and of Dr. Brusina at Zara, especially yielded a vast quantity of new material for a comparison of the marine testacea of the north and south of Europe. Many of the species having been described (some insufficiently) under different names, the difficulty of identification is considerable; but there is no doubt that a remarkable concordance exists, and to a great extent, between the mollusca which inhabit the deeper parts of the Atlantic and Mediterranean seas from 62° to 36° N. lat. The littoral kinds differ much more—a circumstance which may have been occasioned by climatal conditions. To exemplify the former proposition I subjoin a list of 75 species, usually considered northern, which are common to the North Sea and the Mediterranean, with their principal synonyms:—

Names of Species.	*Synonyms.*
Terebratula caput-serpentis, *Linné.*	
Argiope lunifera, *Philippi*	Terebratula cistellula, *Searles Wood.*
Crania anomala, *Müller*	Anomia turbinata, *Poli.*
Pecten septemradiatus, *Müll.*	Ostrea inflexa and O. clavata, *Poli.*
P. aratus, *Gmelin*	P. Bruei, *Payraudeau.*
P. Testæ, *Bivona*	P. furtivus, *Lovén.*
P. striatus, *Müll.*	
P. Hoskynsi, *Forbes*.....	P. imbrifer, *Lov.*
P. vitreus, *Chemnitz*.....	P. Gemellarii-filii, *Biondi.*
P. similis, *Laskey*.....	P. pygmæus, *von Münster.*
Lima Sarsii, *Lov.*.....	Perhaps L. crassa, *Forbes.*
L. elliptica, *Jeffreys.*	
L. subauriculata, *Montagu.*	
Pinna rudis, *L.*.....	P. pectinata of some authors, not of *Linné.*
Mytilus phaseolinus, *Ph.*	
Modiolaria discors, *L.*	
Nucula nitida, *G. B. Sowerby.*	
N. tenuis, *Mont.*	N. decipiens, *Ph.*
Leda pygmæa, *v. Münst.*.....	Probably Nucula ægeensis, *Forb.*
Arca obliqua, *Ph.*.....	A. Korenii, *Danielssen.*

Names of Species.	*Synonyms.*
Lepton nitidum, *Turton.*	
Montacuta ferruginosa, *Mont.*	
Lucina borealis, *L.*	
Axinus Croulinensis, *Jeffr.*	
Cyamium minutum, *Fabricius.*	
Cardium minimum, *Ph.*	C. suecicum, *Lov.*
Astarte sulcata, *Da Costa*	Tellina fusca, *Poli.*
Lucinopsis undata, *Pennant*	Venus incompta, *Ph.*
Tellina balthica, *L.*	T. rubiginosa, *Poli.*
T. pusilla, *Ph.*	
Scrobicularia nitida, *Müll.*	Syndesmya intermedia, *Thompson.*
Lyonsia Norvegica, *Ch.*	Pandorina coruscans, *Scacchi.*
Thracia convexa, *W. Wood*.....	T. ventricosa, *Ph.*
Neæra rostrata, *Spengler*	N. attenuata, *Forb.*
Xylophaga dorsalis, *Turt.*	
Siphonodentalium Lofotense, *Sars.*	
S. quinquangulare, *Forb*.....	S. pentagonum, *Sars.*
Cadulus subfusiformis, *Sars.*	
Chiton Hanleyi, *Bean.*	
C. cancellatus, *G. B. Sow.*	
C. cinereus, *L.*	C. asellus, *Sp.*
C. lævis, *Mont*.....	C. corallinus, *Risso.*
Tectura virginea, *Müll.*	
Propilidium ancyloïdes, *Forb.*	
Scissurella crispata, *Fleming*	S. aspera, *Ph.*, var.
Trochus cinerarius, *L.*, var. variegata.	
Rissoa reticulata, *Mont.*	R. Beanii, *Hanley.*
R. cimicoïdes, *Forb.*	R. sculpta, *F. & H.*, not of *Philippi.*
R. Zetlandica, *Mont.*	
R. abyssicola, *Forb.*	
R. parva, *Mont.*, and var. interrupta	R. obscura and R. simplex, *Ph.*
R. inconspicua, *Alder.*	
R. albella, *Lov*.....	R. Oenensis, *Brusina.*
R. vitrea, *Mont.*	
Jeffreysia diaphana, *Ald*.....	Rissoa? glabra, *Ald.*, not of *Brown.*
J. opalina, *Jeffr.*	
Scalaria Trevelyana, *Leach.*	
Aclis Walleri, *Jeffr.*	
Odostomia clavula, *Lov.*	
O. albella, *Lov.*	
O. umbilicaris, *Malm.*	
O. conspicua, *Ald.*	
O. Scillæ, *Scacchi.*	
O. nitidissima, *Mont.*	
Eulima bilineata, *Ald.*	
Natica catena, *Da C.*	Probably Nerita helicina, *Brocchi.*
Velutina lævigata, *Penn.*	
Cerithium metula, *Lov.*	Mediterranean, *fide Hanley*; perhaps Cerithiopsis Barleei.
Purpura lapillus, *L.*	
Trophon Mörchi, *Malm*	Bela demersa, *Tiberi.*
Bulla utriculus, *Brocchi*	B. Cranchii, *Leach.*
Philine scabra, *Müll.*	Bullæa angustata, *Biv.*
Aplysia punctata, *Cuvier*	A. hybrida, *J. Sowerby.*
Spirialis retroversus, *Fl.*	Scæa stenogyra, *Ph.*; oceanic.
Clio pyramidata, *L.*	Oceanic.

How is this concordance to be accounted for? I have carefully read again Forbes's elaborate essay "On the Connexion between the distribution of the existing Fauna and Flora of the British Isles, and the Geological changes which have affected their area, especially during the epoch of the Northern Drift" (Memoirs of the Geological Survey of Great Britain, vol. i. 1846); but I cannot find in it a satisfactory solution of the question. He, indeed, mentions the continuance of some "arctic" species in the British seas, the rest having "retired for ever," and that certain other species which he called "Boreal or Celtic" occurred in a fossil state in Sicily; and he states (p. 390) that "in the deepest of the regions of depth in the Ægean" the same representation of a northern fauna as exists in our own seas is maintained, "partly by identical and partly by representative forms." The instances he gives do not support such a view; and I am not a believer in "representative forms." He evidently was not aware of the fact that boreal (not arctic) species still live in the Mediterranean. I, however, fully agree with him that at some former time (which he designates "the newer pliocene epoch") there was an open communication between the Atlantic (according to him the "North Seas") and the Mediterranean, by which the fauna became diffused. I should be inclined to place the Atlantic point of communication at Bordeaux, and that of the Mediterranean at Narbonne, in the line of the Languedoc Canal, which extends from one coast to the other, and is very little above the present level of the sea. This communication must have been very wide; and it remained open during the glacial epoch, which affected not only the north of Europe but also Naples, Sicily, and probably Rhodes. Dr. Tiberi showed me a fine valve of *Pecten Islandicus* which had lately been fished up in the Gulf of Naples at a depth of 50 fathoms, and with it a valve of *P. opercularis* quite as large as northern specimens; both the valves were in a semifossil state, and the former was covered with the same Greenland species of *Spirorbis* (*S. cancellatus*, Fabr.) as I noticed on valves of *P. Islandicus* dredged in the Shetland seas at depths varying from 75 to 170 fathoms. Sir Charles Lyell has not adverted, in the last edition of his 'Principles of Geology,' to the remarkable occurrence of such glacial fossils in the Shetland sea-bed, to which I called the attention of geologists in my former Reports as well as in the 2nd volume of 'British Conchology,' p. 58; and he seems to have strangely overlooked the observations of Philippi and Seguenza on the fossils of Calabria and Sicily, when he stated (Princ. Geol. i. p. 298) that "deposits filled with arctic species of marine shells are to

be seen in full force on the North American continent ten or more degrees further south than in Europe." Possibly he was misled by one of Forbes's conclusions (Rep. Geol. Surv. p. 402), that "no glacial beds are known in Southern Europe." This, however, was more than twenty years ago. I have myself identified from the Calabrian and Sicilian deposits several high-northern shells (e. g. *Terebratula cranium*, *T. septata*, *Lima excavata*, *Mytilus modiolus*, *Cyprina Islandica*, *Mya truncata*, var. *Uddevallensis*, *Saxicava Norvegica*, *Puncturella Noachina*, *Emarginula crassa*, *Buccinum undatum*, and *Natica affinis* or *clausa*), and from the Rhodian deposits *Terebratula septata* and *Lima Sarsii*.

My old companion, Mr. Waller, picked up on the beach in a small bay on the west coast of Shetland a shell of *Spirula australis*. It is a tropical Cephalopod, and is not unfrequently thrown up by the waves on the southern and western shores of England, Wales, and Ireland, together with exotic species of *Teredo*, *Ianthina*, and *Hyalæa* brought from southern latitudes. Dr. Mörch informs me that several shells of the *Spirula* have this year been found in the Faroe Isles. The transport of such tropical productions to northern latitudes has been usually attributed to the Gulf-stream. It now, however, appears more probable that this is the consequence, not of the direct action and course of the Gulf-stream, but of the prevalence of westerly and south-westerly winds, which waft onwards to northern latitudes, in a northerly and north-easterly direction, the floating objects carried to a certain distance by the Gulf-stream. The direct course of the Gulf-stream has not been observed further north than about 45° N. lat.; from that point it would seem to dwindle into a north-easterly surface drift. A chart will shortly be published by the Admiralty in explanation of this view of the case; and the following papers on the subject ought to be consulted by physical geographers:—Dr. Stark "On the Temperature of the Sea around the coasts of Scotland during the years 1857 and 1858, and the bearing of the facts on the theory that the mild climate of Great Britain during winter is dependent on the Gulf Stream" (Trans. R. S. Edin. 1859), and Capt. Thomas's tables and remarks in Mr. Alex. Buchan's Report "On the Temperature of the Sea on the Coast of Scotland" (Journ. Scottish Meteor. Soc. Oct. 1865). See also 'Br. Conch.' vol. i. (Introd.) pp. xcviii and xcix.

I will add a short summary of the observations recorded in my Reports on Shetland dredgings and in the work last cited.

1. The bathymetrical zones have been too much divided by Risso and subsequent authors. There are two principal zones,

littoral and submarine; the nature of the habitat and the supply of food influence the residence and migration of animals, not the comparative depth of water. *Psammobia costulata* and *Buccinum undatum* are instances in support of this proposition.

2. Specimens or varieties of the same species are larger in the littoral and laminarian zones than in deeper water: e. g. *Mactra solida* and its variety *elliptica*, *Solecurtus candidus*, *Pandora inæquivalvis* and its variety *obtusa* or *pinna*, *Chiton lævis*, *Tectura virginea*, *Trochus zizyphinus*, *Pleurotoma lævigata*, and *Philine aperta*.

3. The size of North-European specimens is usually greater than that of South-European specimens of the same species: e. g. *Pecten septemradiatus*, *P. opercularis*, *Lima hians*, *Mytilus Adriaticus*, *Isocardia cor*, *Astarte sulcata*, *Venus exoleta*, *V. lincta*, *Tellina balaustina*, *Chiton Hanleyi*, *Tectura virginea*, *Natica Alderi*, *Defrancia teres*, *D. purpurea*, and *Bulla utriculus*.

4. The colour of specimens from the greatest depths is not less vivid than of those from shallow water, although each zone has colourless specimens. *Venus ovata*, *Trochus zizyphinus*, *Turritella terebra*, and *Eulima bilineata* may be mentioned as examples.

5. Mollusca inhabiting deep water have consequently a larger supply of oxygen for the aëration of their gills than those which live in shallow water. See my account of *Columbella haliæeti*.

6. The occurrence of the same species in the North Sea and the Mediterranean results partly from former geological or cosmical conditions, and partly from a communication which once existed between the Bay of Biscay and the Gulf of Lyons.

7. Exotic and oceanic shells are carried northwards by westerly winds, and not directly by the Gulf-stream, which does not reach our coasts.

8. Land and freshwater mollusca are scarce in Shetland, owing to the scantiness of succulent vegetation for their food, and of lime for the construction of their shells. These are smaller than southern specimens; and the same fact is observable with respect to Shetland insects.

9. Semifossil shells of arctic species (such as *Pecten Islandicus*, *Tellina calcarea*, *Mya truncata*, var. *Uddevallensis*, *Mölleria costulata*, *Trochus cinereus*, and *Trophon clathratus*) are met with on the sea-bottom at considerable depths, and at some distance from land. The only explanation I can offer is a former elevation of the sea-bed whereon these mollusks lived (and which was probably in shallow water), and its conversion into dry land, and a subsequent subsidence. Perhaps the sea-bed is still sinking.

10. Species recorded from the Coralline Crag and earlier deposits, and supposed to be extinct, have now been discovered living in the Shetland seas; e. g. *Limopsis aurita*, *Pleurotoma carinata*, and *Columbella haliæeti*. Possibly *Trochus amabilis* is another case, assuming that it originated from *Margarita? maculata* of Searles Wood.

Professor Dickie has been good enough to report on some Diatoms from the insides of a quantity of *Echinus Norvegicus*, which were dredged at a depth of 78 fathoms about forty miles from the east coast of Shetland. He says they are chiefly *Navicula didyma*, *Coscinodiscus excentricus*, *C. minor*, *Actinocyclus undulatus*, and *Melosira sulcata*, with fewer of *M. nummuloïdes* and *Nitzschia angularis*, all marine; also a few freshwater *Cocconema lanceolatum*, *Sinciella minuta*, and fragments of a *Pinnularia*. And he adds that long ago he recorded the occurrence of freshwater kinds of Diatomaceæ mixed with marine kinds from the stomachs of *Ascidiæ* taken in deep water off Aberdeen. The freshwater Diatoms must evidently have been carried by a stream into the sea, and transported by the tide to the place where they sunk to the bottom, and were swallowed by the indiscriminating *Echini* and *Ascidiæ*. Diatoms inhabit the surface only of the water; and *Globigerina* and other Foraminifera not of a fixed or sessile nature have been observed by Major Owen to float when alive within a few inches from the surface. Dr. Wallich found the microscopic organisms which he called coccospheres "profusely in a living, or perhaps it would be more safe to say a recent, condition in material collected at the surface of the open seas of the tropics." Coccospheres and free Foraminifera cover the bed of the Atlantic at enormous depths. The occurrence, therefore, of such organisms on the floor of the ocean at great depths does not prove that they ever lived there. I should rather be inclined to believe that they dropped to the bottom of the sea when dead or after having passed through the stomachs of other animals which had fed on them.

A few small fishes were caught in the dredge at depths of from 90 to 100 fathoms. Dr. Günther reports that they belong to the undermentioned species:—*Callionymus maculatus* (Bonap.), *Gobius Jeffreysii* (Günth.), young, *Cyclopterus lumpus* (L.), young, *Lepadogaster bimaculatus* (Penn.), and *Rhombus Norvegicus* (Günth.), young. He remarks that the last-named species is new to the British fauna, having been hitherto known from the coast of Norway only.

Mr. Norman will report on the Crustacea, Echinoderms, and Sponges, Dr. M'Intosh on the Annelids, and Mr. Waller on the Foraminifera.

Mollusca inhabiting the Shetland Isles and the adjacent seas. (See Tables of distribution in 'British Conchology,' vols. i.–iv.)

Name of Species.	Northern.	Southern.	Remarks as to distribution and synonymy.
MARINE.			
BRACHIOPODA.			
Terebratula cranium, *Müller*	—	—	Vigo (M'Andrew).
caput-serpentis, *Linné*	—	—	
†Terebratella Spitzbergensis, *Davidson*	—		Possibly fossil.
†Rhynchonella psittacea, *L.*	—		Possibly fossil.
Argiope lunifera, *Philippi*	—	—	*Terebratula cistellula*, S. Wood.
Crania anomala, *Müller*	—	—	*Anomia turbinata*, Poli.
	6	6	4
CONCHIFERA.			
Anomia ephippium, *L.*	—	—	
patelliformis, *L.*	—	—	
Ostrea edulis, *L.*	—	—	
Pecten pusio, *L.*	—	—	
opercularis, *L.*	—	—	
septemradiatus, *Müll.* ..	—	—	
†aratus, *Gmelin*	—	—	*P. Bruei*, Payraudeau.
tigrinus, *Müll.*	—	—	
†Testæ, *Bivona*	—	—	
striatus, *Müll.*	—	—	
†Hoskynsi, *Forbes*	—	—	*P. imbrifer*, Lovén.
similis, *Laskey*	—	—	
maximus, *L.*	—	—	
†Lima Sarsii, *Lov.*	—	—	
†elliptica, *Jeffreys*	—	—	
subauriculata, *Mont.*	—	—	
Loscombii, *G. B. Sowerby* ..	—	—	
Pinna rudis, *L.*		—	*P. pectinata* of some authors, not of Linné.
Mytilus edulis, *L.*	—	—	
modiolus, *L.*	—		Fossil in Calabria and Sicily.
Adriaticus, *Lamarck*	—	—	
phaseolinus, *Ph.*	—	—	
Modiolaria marmorata, *Forbes* ..	—	—	
discors, *L.*	—	—	
nigra, *Gray*	—		
Crenella decussata, *Mont.*	—		
Nucula nucleus, *L.*	—	—	
nitida, *G. B. Sow.*	—	—	
tenuis, *Mont.*	—	—	

Name of Species.	Northern.	Southern.	Remarks as to distribution and synonymy.
Leda pygmæa, *von Münster*	—	—	
minuta, *Müll.*	—		
†pernula, *Müll.*	—		Possibly fossil.
†Limopsis aurita, *Brocchi*			Fossil in the Coralline Crag, and in miocene and pliocene beds on the Continent. Perhaps an arctic species.
Pectunculus glycymeris, *L.*	—	—	
Arca pectunculoïdes, *Scacchi*	—	—	
†obliqua, *Ph.*	—	—	
tetragona, *Poli*	—	—	
Lepton nitidum, *Turton*	—	—	
Clarkiæ, *Clark*			
Montacuta substriata, *Mont.*	—	—	
†donacina, *S. Wood* ..			A Coralline Crag fossil.
bidentata, *Mont.*	—	—	
†tumidula, *Jeffr.*	—		
ferruginosa, *Mont.* ..	—	—	
Lasæa rubra, *Mont.*	—	—	
Kellia suborbicularis, *Mont.*	—	—	
†cycladia, *S. Wood*		—	Coralline Crag.
Lucina spirifera, *Mont.*	—	—	
borealis, *L.*	—	—	
Axinus flexuosus, *Mont.*	—	—	
†Croulinensis, *Jeffr.*		—	
ferruginosus, *Forb.*	—	—	
Cyamium minutum, *Fabricius* ..	—	—	
Cardium echinatum, *L.*	—	—	
exiguum, *Gmelin*	—	—	
fasciatum, *Mont.*	—	—	
nodosum, *Turt.*	—	—	
edule, *L.*	—	—	
minimum, *Ph.*	—	—	
Norvegicum, *Spengler* ..	—	—	
Isocardia cor, *L.*	—	—	
Cyprina Islandica, *L.*	—		Fossil at Nice and in Sicily.
Astarte sulcata, *Da Costa*	—	—	
compressa, *Mont.*	—		
triangularis, *Mont.*		—	
Circe minima, *Mont.*	—	—	
Venus exoleta, *L.*	—	—	
lincta, *Pulteney*	—	—	
fasciata, *Da C.*	—	—	
Casina, *L.*	—	—	
ovata, *Pennant*	—	—	
gallina, *L.*	—	—	
Tapes virgineus, *auct.*	—	—	Probably not *Venus virginea* of Linné.
pullastra, *Mont.*	—	—	

Name of Species.	Northern.	Southern.	Remarks as to distribution and synonymy.
Tapes decussatus, *L.*		—	Fossil in Sweden and Norway.
Lucinopsis undata, *Penn.*	—	—	
? Gastrana fragilis, *L.*	?—	—	Zetlandic on the authority of Forbes, and Norwegian on that of M'Andrew.
Tellina balaustina, *L.*		—	
crassa, *Penn.*	—	—	
balthica, *L.*	—	—	
tenuis, *Da C.*	—	—	
fabula, *Gronovius*	—	—	
donacina, *L.*		—	
pusilla, *Ph.*	—	—	
Psammobia tellinella, *Lam.*	—	—	
costulata, *Turt.*	—	—	
Ferröensis, *Chemnitz*	—	—	
Mactra solida, *L.*	—	—	
subtruncata, *Da C.*	—	—	
stultorum, *L.*	—	—	
Lutraria elliptica, *Lam.*	—	—	
Scrobicularia prismatica, *Mont.*..	—	—	
nitida, *Müll.*	—	—	
alba, *W. Wood* ..	—	—	
Solecurtus candidus, *Renier*		—	Boulder-clay of Caithness (Peach).
antiquatus, *Pult.*	—	—	
Solen pellucidus, *Penn.*	—	—	
ensis, *L.*	—	—	
siliqua, *L.*	—	—	
Pandora inæquivalvis, *L.*	—	—	The northern and deep-water variety is *Solen pinna* of Montagu = *P. obtusa*, Leach.
Lyonsia Norvegica, *Ch.*	—	—	
Thracia prætenuis, *Pult.*	—	—	
papyracea, *Poli*	—	—	*Amphidesma phaseolina*, Lam.
convexa, *W. Wood*	—	—	
distorta, *Mont.*	—	—	
Poromya granulata, *Nyst* and *Westendorp*	—	—	
Neæra abbreviata, *Forb.*	—	—	
costellata, *Deshayes*	—	—	
†rostrata, *Sp.*	—	—	
cuspidata, *Olivi*	—	—	
Corbula gibba, *Ol.*	—	—	
Mya truncata, *L.*	—		Fossil in Sicily.
†Panopea plicata, *Mont.*	—	—	
Saxicava Norvegica, *Sp.*.....	—		Shetland (M'Andrew). Fossil in Sicily.

Name of Species.	Northern.	Southern.	Remarks as to distribution and synonymy.	
Saxicava rugosa, *L.*	—	—		
Pholas crispata, *L.*	—	?—	Marseilles (Matheron, *fide* Philbert).	
Xylophaga dorsalis, *Turt.*	—	—		
Teredo norvegica, *Sp.*	—	—		
megotara, *Hanley*	—	—		
	119	108	106	
SOLENOCONCHIA.				
Dentalium entalis, *L.*	—	?—		
†Siphonodentalium Lofotense, *Sars*	—	—		
†Cadulus subfusiformis, *Sars*	—	—		
	3	3	3	
GASTROPODA.				
Chiton fascicularis, *L.*	—	—		
Hanleyi, *Bean*	—	—	Dredged by Capt. Acton in the Gulf of Naples.	
cancellatus, *Leach*?	—	—		
cinereus, *L.*	—	—		
albus, *L.*	—			
marginatus, *Penn.*	—	—		
ruber, *Lowe*	—			
lævis, *Mont*	—	—		
marmoreus, *Fabr.*	—			
Patella vulgata, *L.*	—	—		
Helcion pellucidum, *L.*	—	—		
Tectura testudinalis, *Müll.*	—			
virginea, *Müll.*	—	—		
fulva, *Müll.*	—			
†Lepeta cæca, *Müll.*	—			
Propilidium ancyloïdes, *Forb.*	—	—		
Puncturella Noachina, *L.*	—		Fossil in Sicily.	
Emarginula fissura, *L.*	—	—		
crassa, *J. Sowerby*	—	—	Fossil in Calabria as *E. decussata* (Ph.), and in Sicily (Seguenza).	
?Fissurella græca, *L.*		—	Zetlandic on Forbes's authority.	
Capulus Hungaricus, *L.*	—	—		
Scissurella crispata, *Fleming*	—	—	*S. aspera*, Ph., appears to be the southern form or variety.	
Cyclostrema nitens, *Ph.*		—		
serpuloïdes, *Mont.*	—	—		
Trochus helicinus, *Fabr.*	—			
Grœnlandicus, *Ch.*	—			
†amabilis, *Jeffr.*				

Name of Species.	Northern.	Southern.	Remarks as to distribution and synonymy.
Trochus magus, *L.*	—	—	
tumidus, *Mont.*	—	—	
cinerarius, *L.*	—	—	The southern form is the variety *variegata*.
Montacuti, *W. Wood*		—	
millegranus, *Ph.*	—	—	
zizyphinus, *L.*	—	—	
occidentalis, *Mighels*	—		
Lacuna crassior, *Mont.*			Probably arctic.
divaricatus, *Fabr.*	—	—	Gulf of Gascony.
puteolus, *Turt.*	—	—	Corunna and Vigo (M'Andrew).
pallidula, *Da C.*	—	—	Arcachon (Fischer).
Littorina obtusata, *L.*	—	—	North of Spain, and Vigo; the Mediterranean localities are doubtful.
neritoïdes, *L.*	—	—	
rudis, *Maton*	—	—	Corunna and Lisbon (M'Andrew); Algiers (J. W. Flower).
littorea, *L.*	—	—	Corunna and Lisbon (M'Andrew); the Mediterranean and Adriatic localities are doubtful.
Rissoa reticulata, *Mont.*	—	—	
cimicoïdes, *Forb.*	—	—	
†Jeffreysi, *Waller*	—		
punctura, *Mont.*	—	—	
abyssicola, *Forb.*	—	—	
Zetlandica, *Mont.*	—	—	
costata, *Adams*	—	—	Shetland, *fide* Barlee.
parva, *Da C.*	—	—	
inconspicua, *Ald.*	—	—	
†albella, *Lov.*	—	—	Adriatic, as *R. Oenensis* (Brusina).
membranacea, *Ad.*	—	—	
violacea, *Desmarets*	—	—	
striata, *Ad.*	—	—	
proxima, *Ald.*		—	
vitrea, *Mont.*	—	—	Shetland, *fide* Fleming.
soluta, *Ph.*	—	—	
semistriata, *Mont.*	—	—	Shetland, *fide* Barlee.
cingillus, *Mont.*	—	—	
Hydrobia ulvæ, *Penn.*	—	—	*Turbo stagnalis*, L.
Jeffreysia diaphana, *Ald.*		—	
opalina, *Jeffr.*		—	
globularis, *Jeffr.*			
Skenea planorbis, *Fabr.*	—	—	
Homalogyra atomus, *Ph.*	—	—	
rota, *F. & H.*	—	—	

Name of Species.	Northern.	Southern.	Remarks as to distribution and synonymy.
Cæcum glabrum, *Mont.*	—	—	
Turritella terebra, *L.*	—	—	
Scalaria Trevelyana, *Leach*	—	—	
clathratula, *Ad.*	—	—	
Aclis unica, *Mont.*		—	
ascaris, *Turt.*	—	—	Dalmatia (Brusina).
supranitida, *S. Wood*	—	—	
†Walleri, *Jeffr.*	—	—	Gulf of Naples (Stefanis).
Gulsonæ, *Cl.*		—	Vigo Bay (M'Andrew).
†Odostomia minima, *Jeffr.*			
nivosa, *Mont.*			
clavula, *Lov.*	—	—	Gulf of Naples (Tiberi and Acton).
†Lukisi, *Jeffr.*		—	Dalmatia (Brusina); Sicily (Tiberi).
†albella, *Lov.*	—	—	Dalmatia (Brusina).
pallida, *Mont.*	—	—	*O. Novegradensis*, Brus.
conoïdea, *Brocchi*	—	—	
†umbilicaris, *Malm*	—	—	Gulf of Naples (Acton).
acuta, *Jeffr.*	—	—	
conspicua, *Ald.*	—	—	
unidentata, *Mont.*	—		Loire-Inférieure (Caillaud).
turrita, *Hanl.*	—	—	
insculpta, *Mont.*	—		Brittany (Cailliaud and Taslé).
†diaphana, *Jeffr.*			
obliqua, *Ald.*	—	—	Dalmatia (Brusina); Naples (Stefanis).
Warreni, *Thompson*		—	
indistincta, *Mont.*	—	—	
interstincta, *Mont.*	—	—	
spiralis, *Mont.*	—	—	Adriatic (Stossich).
eximia, *Jeffr.*	—		
scalaris, *Ph.*	—	—	
rufa, *Ph.*	—	—	
Scillæ, *Scacchi*	—	—	Gulf of Naples (Stefanis); Madeira and Canaries (M'Andrew).
acicula, *Ph.*	—	—	
nitidissima, *Mont.*	—	—	Adriatic and Mediterranean.
Stilifer Turtoni, *Broderip*	—	—	Canary Isles (M'Andrew).
Eulima polita, *L.*	—	—	
intermedia, *Cantraine*	—	—	
distorta, *Desh.*, sec. *Ph.*	—	—	*E. Philippii*, Weinkauff.
†stenostoma, *Jeffr.*	—		
?subulata, *Donovan*	? —	—	Shetland, *fide* Forbes; Norway, *fide* Lovén and Danielssen.
bilineata, *Ald.*	—	—	Adriatic and Mediterranean.

Name of Species.	Northern.	Southern.	Remarks as to distribution and synonymy.
Natica Islandica, *Gm.*	—		
Grœnlandica, *Beck.*	—		
sordida, *Ph.*		—	Perhaps *N. fusca*, De Blainville.
catena, *Da C.*	—	—	
Alderi, *Forb.*	—	—	
Montacuti, *Forb.*	—		Fossil in Sicily.
Lamellaria perspicua, *L.*	—	—	
Velutina plicatilis, *Müll.*	—		
lævigata, *Penn.*	—	—	
†Torellia vestita, *Jeffr.*	—		
Trichotropis borealis, *Brod. & Sow.*	—		
Aporrhaïs pes-pelecani, *L.*	—	—	
Macandreæ, *Jeffr.*	—		Fossil in Sicily.
Cerithium metula, *Lov.*	—	?—	Villafranca (Hanley); perhaps *Cerithiopsis Barleei.*
perversum, *L.*	—	—	
Cerithiopsis tubercularis, *Mont.*	—	—	
Metaxa, *Delle Chiaje*		—	Shetland, *fide* Barlee.
†costulata, *Möller*	—		
Purpura lapillus, *L.*	—	—	
Buccinum undatum, *L.*	—	—	Gulf of Lyons (Martin). Fossil in Sicily and Calabria.
Humphreysianum, *Bennett*	—		Fossil in Sicily and Calabria.
Buccinopsis Dalei, *J. Sow.*	—		
Trophon Barvicensis, *Johnston*	—		
truncatus, *Ström*	—		
Fusus antiquus, *L.*	—	—	
Norvegicus, *Ch.*	—		
Turtoni, *Bean*	—		An embryo-capsule only in Shetland.
†Islandicus, *Ch.*	—		
gracilis, *Da C.*	—	—	Bay of Biscay.
propinquus, *Ald.*	—		Brittany (Taslé).
Berniciensis, *King*	—	?—	Arcachon (Fischer).
Nassa reticulata, *L.*	—	—	
incrassata, *Str.*	—	—	
†Columbella haliæeti, *Jeffr.*	—		Fossil in the Sicilian and other tertiary beds.
nana, *Lov.*	—		Genus *Thesbia.*
Defrancia teres, *Forb.*	—	—	
gracilis, *Mont.*		—	
Leufroyi, *Michaud*	—	—	
linearis, *Mont.*	—	—	
†reticulata, *Ren.*	—	—	
purpurea, *Mont.*	—	—	
Pleurotoma costata, *Don.*	—	—	
brachystoma, *Ph.*	—	—	

Name of Species.	Northern.	Southern.	Remarks as to distribution and synonymy.
Pleurotoma nebula, *Mont.*	—	—	The variety *elongata* is the Shetland form.
†nivalis, *Lov.*.....	—		Fossil in the Coralline Crag.
†carinata, *Biv.*	—		Fossil in Calabria and the Suffolk Crag.
turricula, *Mont.*	—		North of France.
Trevelyana, *Turt.* ..	—		
Marginella lævis, *Don.*		—	
Cypræa Europæa, *Mont.*.....	—	—	
Cylichna acuminata, *Bruguière* ..	—	—	
nitidula, *Lov.*	—	—	Gulf of Naples (Stefanis).
umbilicata, *Mont.*	—	—	
cylindracea, *Penn.*	—	—	
†alba, *Brown*	—		
Utriculus mammillatus, *Ph.*	—	—	
truncatulus, *Brug.*	—	—	
obtusus, *Mont*.....	—	—	Bay of Biscay and the Adriatic.
†expansus, *Jeffr.*	—		
hyalinus, *Turt.*	—	—	
†globosus, *Lov.*	—		
Acera bullata, *Müll.*	—	—	
Actæon tornatilis, *L.*	—	—	
Bulla utriculus, *Brocchi*	—	—	
Scaphander lignarius, *L.*	—	—	
†librarius, *Lov.*.....	—		
Philine scabra, *Müll.*	—	—	
catena, *Mont.*		—	Shetland, *fide* Barlee.
†angulata, *Jeffr.*			
quadrata, *S. Wood*	—		
punctata, *Cl.*	—	—	
pruinosa, *Cl.*	—	—	Dalmatia (Brusina).
†nitida, *Jeffr.*			
aperta, *L.*	—	—	
Aplysia punctata, *Cuv.*	—	—	*A. hybrida*, J. Sow.
Doris tuberculata, *Cuv.*	—	—	
Zetlandica, *Alder & Hancock*			
Johnstoni, *A. & H.*	—		
repanda, *A. & H.*	—		
? muricata, *Müll.*	—		Alder.
bilamellata, *L.*	—		*D. fusca*, Müll.
pilosa, *Müll.*	—	—	
Goniodoris nodosa, *Mont.*	—		
Triopa claviger, *Müll.*.....	—		
Polycera quadrilineata, *Müll.* ..	—	—	
Ancula cristata, *Ald.*	—		
Idalia Leachii, *A. & H.*			Norman.
inæqualis, *Forb.*			
Tritonia Hombergi, *Cuv.*	—	—	
plebeia, *Johnst.*.....	—		

Name of Species.	Northern.	Southern.	Remarks as to distribution and synonymy.
Ægires punctilucens, *D'Orbigny*	—	—	
Dendronotus arborescens, *Müll.*	—		
Doto fragilis, *Forb.*	—		
coronata, *Gm.*	—	—	
cuspidata, *A. & H.*			
Eolis papillosa, *L.*	—		
coronata, *Forb.*	—		
rufibranchialis, *Johnst.*	—		
pellucida, *A. & H.*	—		Norman. Not *Doris pellucida*, Risso.
alba, *A. & H.*	—		
olivacea, *A. & H.*			
aurantiaca, *A. & H.*	—		Norman.
?tricolor, *Forb.*	—		Alder.
picta, *A. & H.*			Norman.
despecta, *Johnst.*			
Hermæa bifida, *Mont.*	—		
Embletonia minuta, *Forbes & Goodsir*			
Antiopa cristata, *Delle Ch.*		—	Norman.
Limapontia nigra, *Johnst.*	—		
Melampus bidentatus, *Mont.*		—	
218	185	140	
PTEROPODA.			
Spirialis retroversus, *Fl.*	—	—	
Macandrei, *F. & H.*	—	—	Query if distinct from last?
†Clio pyramidata, *L.*	—	—	
†infundibulum, *S. Wood*			Coralline Crag.
4	3	3	
CEPHALOPODA.			
Octopus vulgaris, *Lam.*	—	—	
Rossia macrosoma, *Delle Ch.*	—	—	
†?glaucopis, *Lov.*	—		Lovén.
Sepia officinalis, *L.*	—	—	
4	4	3	
And probably an undescribed species of *Rossia* or an allied genus, Lovén.			
LAND AND FRESHWATER.			
CONCHIFERA.			
Pisidium nitidum, *Jenyns*	—	—	
roseum, *Scholtz*	—	—	
2	2	2	

Name of Species.	Northern.	Southern.	Remarks as to distribution and synonymy.
GASTROPODA.			
Planorbis nautileus, *L.*	—	—	
glaber, *Jeffr.*	—	—	
contortus, *L.*	—	—	
Limnæa peregra, *Müll.*	—	—	
truncatula, *Müll.*	—	—	
Arion ater, *L.*	—	—	
Limax agrestis, *L.*	—	—	
lævis, *Müll.*	—	—	*L. brunneus*, F. & H.; not Draparnaud's species of that name.
marginatus, *Müll.*	—		*L. arborum*, Bouchard-Chantereaux.
maximus, *L.*	—	—	
Succinea putris, *L.*	—	—	
elegans, *Risso*	—	—	
Vitrina pellucida, *Müll.*	—	—	
Zonites cellarius, *Müll.*	—	—	
alliarius, *Miller*	—	—	
Helix nemoralis, *L.*, var. hortensis	—	—	
arbustorum, *L.*	—	—	
rotundata, *Müll.*	—	—	
Pupa umbilicata, *Draparnaud*	—	—	
Clausilia rugosa, *Dr.*	—	—	
Cochlicopa lubrica, *Müll.*	—	—	
21	21	20	

Summary.

	Shetland.	Northern.	Southern.	Total British.	Remarks.
MARINE.					
Brachiopoda	6	6	4	8	
Conchifera	119	108	106	168	
Solenoconchia	3	3	3	4	
Gastropoda	218	185	140	399	The last figure is thus made up:— Testaceous 289 Nudibranchs .. 110 — 399
Pteropoda	4	3	3	4	The number of marine species in Lovén's 'Index' of Scandinavian mollusca is 345, including 40 Nudibranchs.
Cephalopoda	4	4	3	15	
	354	309	259	598	
LAND AND FRESHWATER.					
Conchifera	2	2	2	47	
Gastropoda	21	21	20	75	
	377	332	281	720	

Obs. The Shetland Nudibranchs and Cephalopods have not been sufficiently investigated. Lovén's 'Index' and a further list of Swedish Nudibranchs which he lately sent me contain 60 species of that order, out of which 22 only have been identified as Zetlandic. He also gives 9 species of Cephalopods, of which 3 only are Zetlandic. The southern distribution of our Nudibranchs is very little known. For the preparation of the present list of Nudibranchs I am in a great measure indebted to the late Mr. Alder and to Mr. Norman. Forty-five species of mollusca (marked †) have been discovered in the Shetland seas since the publication of Forbes & Hanley's 'History of British Mollusca and their Shells.'

MISCELLANEOUS.

On a new Class of Echinodermata.

By C. Semper.

M. Semper has made an anatomical investigation of the genus *Rhopalodina* of Gray, which has led him to rather remarkable results. The animal had been classed by Dr. Gray, because of the form of its body, among the Holothuriæ. This body is formed of an anterior part having the form of a cylindrical peduncle, and of a spherical posterior part or abdomen. In this hinder region, at the point opposed to the insertion of the peduncle, are seen ten ambulacra, to which correspond in the interior, as in the Holothuriæ, ten radiating muscles, ten aquiferous canals with their ampullæ, and ten nerves. These ten rays of the abdomen, moreover, are prolonged into the peduncle, but without bearing any feet.

At the free extremity of the peduncle are the mouth and the anus, side by side. The margin of the mouth is entire; that of the anus is formed by a circle of ten papillæ. The tentacular crown of the pharynx is formed of ten pennated tentacles, which, in the two individuals studied by M. Semper, were hidden in the buccal cavity. The pharynx and the terminal part of the intestine consequently pass side by side in the interior of the peduncle. At the point where the peduncle enlarges to form the spherical abdomen, the anal intestine bears four long cæca, like the lungs of the Holothuriæ. At the corresponding point of the pharynx, between that organ and the intestine, appears a little swelling, serving as the point of attachment of a crowd of little blind tubes. These are the generative organs, constructed on the type of those of the Holothuriæ. The stomach forms in the abdomen a spiral with numerous turns and a double loop.

Of the ten rays above mentioned, five correspond with the pharynx and five with the intestine. The five radial muscles of the pharynx are attached, as in the Holothuriæ, to five radial pieces of the calcareous pharyngeal ring, which is formed of ten pieces in all. In this place there ought to exist a circular aquiferous vessel, as follows from the existence of two vesicles of Poli. Round the anus,

immediately below the crown of anal papillæ, there is also a calcareous ring composed of ten pieces, of very regular form; and the five radiate muscles of the intestine are attached to the five radial pieces. The calcareous ring of the pharynx is placed a little deeper in the peduncle than that of the intestine; therefore a section of the peduncle at the level of the root of the buccal tentacles shows plainly the five radial muscles of the intestine, but not those of the pharynx. The small dimensions of the object have not, unfortunately, allowed it to be ascertained how the aquiferous vessels of the rays behave in the neighbourhood of the calcareous rings. The existence of a double calcareous ring and the division of the rays into five intestinal and five pharyngeal rays might lead us to suppose that there exist two circular vessels. If, however, we admit, despite this arrangement, a single nervous ring and a single circular aquiferous vessel, it is still no less impossible to refer this singular animal to the typical form of the Holothuriæ, notwithstanding the incontestable affinities that have been indicated in the internal organs. We might, it is true, suppose the *Rhopalodinæ* to have resulted from a *Psolus* or *Colochirus* whose buccal and anal cones had been much elongated and soldered to one another; but although that transformation might produce a form analogous to *Rhopalodina*, the rays could not be arranged as in these animals. The two dorsal rays should, on the contrary, disappear entirely, and we ought to find on the peduncle two groups of three rays becoming continued one into the other at the extremity of the abdomen.

In all living Echinoderms the anus is placed either opposite to the mouth in the centre of the radiate arrangement or in an interradium. In some fossil Crinoids alone (the *Crinoidea tessellata*) there exist more than five rays placed round a single central aperture. These are in reality the only Echinoderms in which we could suppose an arrangement of the pharynx and intestine in relation to the rays like that which M. Semper has described in *Rhopalodina*. Yet these latter could not be united with the Crinoids, because of the totally different structure of their ambulacra, leaving out of consideration that their internal organs approximate them much more to the Holothuriæ.

The author does not see any other way of getting out of the difficulty than to create for these singular animals a new class, under the name of *Echinodermes diplostomes*. He promises us a detailed description of the genus *Rhopalodina* in a supplement to his great work on the Holothuriæ. — *Verhandl. phys.-med. Gesellsch. in Würzburg*, June 6, 1868: *Bibl. Univ.* August 15, 1868, *Bull. Sci.* pp. 326–328.

Coccoliths and Coccospheres. By G. C. Wallich.

September 7, 1868.

In a lecture "On a Piece of Chalk," delivered by Prof. Huxley to working men during the recent meeting of the British Association, and published with the author's initials in the September number of

'Macmillan's Magazine,' attention is directed to certain minute bodies to which he gave the name of "coccoliths," as met with in soundings obtained in 1857 by Capt. Dagman in H.M.S. 'Cyclops.' Speaking of these bodies, the author says, "Dr. Wallich verified my observation and added the interesting discovery that not unfrequently bodies similar to these coccoliths were aggregated together into spheroids, which he termed coccospheres." He goes on to say that "A few years ago Mr. Sorby, in making a careful examination of the chalk, by means of sections and otherwise, observed, as Ehrenberg had done before him, that much of the granular basis possesses a definite form. Comparing these formed particles with those in the Atlantic soundings *he* found the two to be identical, and thus proved that the chalk, like the soundings, contains these mysterious coccoliths and coccospheres."

In the above extract I will, with your permission, point out one or two inaccuracies, no doubt unintentional on Prof. Huxley's part, but of sufficient importance to induce me to beg you will afford me the opportunity of correcting them, and at the same time of drawing the attention of naturalists to some additional facts connected with the bodies in question.

The occurrence of the spheroidal objects to which I assigned the name of coccospheres, as being most intimately connected with the coccoliths of Prof. Huxley, was detected by me in North Atlantic soundings, whilst on the surveying cruise of H.M.S 'Bulldog,' in July 1860, a general notice of their existence having appeared in my 'Notes on the Presence of Animal Life at great Depths in the Sea' in November of the same year, and a detailed description, with figures and measurements, having been published by me in the Ann. & Mag. Nat. Hist. in July 1861. The identification of the coccoliths of the soundings with those of the chalk (to the last of which attention was drawn by Ehrenberg and Mr. Sorby) was announced for the first time in the two papers just referred to, Mr. Sorby's paper having appeared in the 'Annals' in September 1861. In this paper Mr. Sorby actually refers to the spheroidal bodies under the name I gave them. The merit of the identification spoken of by Prof. Huxley, such as it is, I have therefore a right to claim as mine.

The coccoliths, however, cannot correctly be said to be "aggregated together into the spheroids," as stated in the lecture. They are in reality arranged, at intervals, over the surface of the spheroidal cell, on which their concave surfaces rest, and which is, to this extent, a separate portion of the structure. When detached, as they invariably appear to be in the chalk and the fossil earths (of which I shall have occasion to say a word presently), they bear the same relation to the supporting cell that the fallen fruit bears to the tree that bore it, and nothing more.

Of their true position in the organic world I am ignorant. But I have these important facts to add (referred to by me incidentally in a paper on "The Polycystina," which was read before the Royal Microscopical Society in May 1865, and published in the Transac-

tions of that Society), that I have detected coccoliths in abundance, and retaining their normal characters, in some of the fossil siliceous earths of Barbadoes &c., and that coccospheres have been met with by me profusely in a living, or perhaps it would be more safe to say, a recent condition, in material collected at the surface of the open seas of the tropics, and also in dredgings from shoal water obtained off the south coast of England.

It only remains for me to add that, so far as the chemical nature of these bodies can be ascertained by reagents and the polariscope, there is reason to believe that carbonate of lime enters largely into their composition; and they furnish us with another striking example, in which simplicity of structure has enabled an organism to weather the vicissitudes to which the surface of the globe has been subject, and under the operation of which more complex forms have ceased to exist.—*Athenæum for* Sept. 19, 1868.

Transporting Fish alive.

Mr. Moore, the Curator of the Liverpool Free Museum, has succeeded in importing some living fish from the River Plate, the first living fish that he has received from the south of the equator. Some Gwyniad fish sent out by the same captain arrived safely; and he left Liverpool on the 11th of this month with another series of fish. They were sent out and imported in a common fish-globe suspended like a cabin-lamp, in gimbals.

There are now exhibited in the Liverpool Museum two catfish, three pomotis, two species of *Cyprinus*, four axolotls, and a *Proteus* that were imported from New York by the same method.—J. E. Gray.

On Tetilla euplocamos *and* Hyalonema boreale.
By Dr. J. E. Gray, F.R.S. &c.

It is a curious coincidence that three small-peduncled capitate sponges should be discovered about the same time, viz.:—

1. *Hyalonema boreale*, Lovén, from the North Sea.
2. *Lovenia boreale* of Bocage, coast of Portugal.
3. *Tetilla euplocamos*, Oscar Schmidt, Spongien von Algier, t. 5. f. 10, from Brazil.

There can be no doubt that they are all distinct species; and the spicules show that the North-Sea and Portuguese species must be referred, according to my views, to different families—the one to Halichondriadæ and the other to Tethyadæ. Unfortunately *Tetilla* is not regularly described by Dr. Oscar Schmidt.

It is curious that Dr. O. Schmidt, like Dr. Lovén and M. Bocage, compares the small-peduncled sponge to *Hyalonema*. The *Tetilla* was sent to him from Brazil by M. F. Müller. He observes, "The pear-shaped body is like *Tethya*, and the peduncle is like *Hyalonema*; the body is formed of clustered spicules with abundance of thrice-forked spicules, the forks projecting, and covering the surface

like down; the peduncle is formed of spirally twisted threads, and divides below into a few rootlets:" and he believes that the sponge grows sticking in the mud.

Dr. O. Schmidt kindly sent me a slide with specimens of the spicules of *Tetilla*, but I do not find any trifurcated spicules on it; one of them is figured across the base of the sponge, t. 5. f. 10. It also belongs to Tethyadæ.

On Hyalonema, *Gray.*

Professor E. Perceval Wright of Dublin has just returned from Setuval, where, with the kind assistance of Prof. Bocage of Lisbon, he has succeeded in dredging living specimens of this strange organism. The *Hyalonema*-ground is in a valley, some thirty miles to sea, south-west of Setuval, and is from 400 to 500 fathoms in depth. Prof. Wright "regards the siliceous axis as the stem of the "sponge-mass called *Carteria* by Dr. J. E. Gray, and has deter- "mined that the end of the axis, where the fibres become loose, is "that one imbedded in the mud, the sponge-mass being on the "summit, and presenting forms of very various outline. The "sponge-mass is provided with a number of oscula looking upwards, "these being covered over by a beautiful open network of spicules. "When the sponge-mass is washed away or destroyed, the parasitic "*Palythoa*, which was seen living, and in the act of protruding its "tentacles, grows up over that portion of the siliceous axis which is "left uncovered by the mud; but numerous examples of the sili- "ceous stem exist uncovered by the parasite. The Lisbon Museum "has now, thanks to Prof. Bocage, the most magnificent series of "this sponge in the world." Prof. Wright will shortly publish fuller details of this interesting discovery.

Castle, Dublin, Sept. 22nd.

My Dear Dr. Gray,—Many thanks for your kind note, which I got on my return from the expedition Carpenter and I made to the North Sea * * * * *

Now, as to our expedition. In the mud of the Gulf Stream (at 550 fathoms) we got *Hyalonema* living *upside down*, as I already suspected from Lovén's paper; but, besides *Hyalonema*, we got at least half a dozen new forms of vitreous sponges, most remarkable, and some of them as beautiful as the flower-basket.

Of these you will, of course, get specimens; but in the first place I must clean and prepare them and describe them for the 'Phil. Trans.'

In another locality we got *Brisinga* and the wonderful little Crinoid *Rhizocrinus* * * * * *

Ever truly yours,
Wyville Thomson.

THE ANNALS

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Long Island HISTORICAL Society.

XXXVIII.—*On the Occurrence of the Palatal Teeth of a Fish belonging to the Genus* Climaxodus, *M'Coy, in the Low-main Shale of Newsham.* By THOMAS ATTHEY*.

IN this communication I wish to make known the discovery of some palatal teeth which have occurred to me during the investigations I have made in the black shale of the Low-main seam of Newsham. Some of these have been in my possession more than eight years, others have been found recently. In the hope of obtaining more perfect information relative to these curious teeth, a notice of their occurrence in this locality has hitherto been delayed; but it seems desirable to give a short notice of their discovery at the present time, preparatory to a more lengthened and careful description of them.

Fourteen specimens of various sizes have occurred to me during the above-named period. Some of these are isolated palatal teeth; but on one slab of shale, about four inches long and two and a half broad, there are remains of not less than eight teeth; and from the manner in which they are imbedded, and the presence of great numbers of minute dermal tubercles in connexion with them, there can be no doubt that they all belonged to one individual.

The general form of the upper surface of the tooth is ovate. This upper surface is supported by a bony process, which springs from the under surface and projects beyond the smaller extremity. The narrow portion of the upper surface is crossed by from four to six transverse imbricating ridges. In the larger specimens these ridges are strongly undulated, with the upper edge roughly broken up into coarse granulations. The broader portion of this surface is occupied by a very wide furrow or hollow bounded at the broad end by a sharp, slightly

* Communicated by the Author, having been read at the Meeting of Tyneside Naturalists, Oct. 9, 1868.

denticulated margin. The narrow portion of the surface is ornamented with minute granulations; the broad furrow is striated in the direction of the length of the tooth. Three of the teeth are somewhat shorter than the rest; or, in other words, they have a more circular form.

The largest tooth measures, including the projecting bony process, an inch and a quarter in length, and is about seven-eighths of an inch wide in the broadest part. The smallest tooth is rather more than three-eighths of an inch long, and very nearly the same in the broadest part. In the small specimens the groove at the broad end is nearly as large as the remaining portion of the tooth.

On comparing these teeth with the figure given by M'Coy (British Palæozoic Fossils, pl. 3 G. f. 5) of his *Climaxodus imbricatus*, they are found to agree in having the narrow portion of the tooth ornamented with transverse ridges; but a further comparison cannot at present be made, as the figure given by M'Coy was from a specimen broken at both ends.

As it appears to be advisable to attach some name to this interesting fossil, and seeing that it agrees in some essential points with the genus *Climaxodus*, M'Coy, I propose to refer it provisionally to that genus, and, further, to distinguish the species which I have found at Newsham by the name of *Climaxodus linguæformis*.

Also I avail myself of the present occasion to announce that, in addition to *Climaxodus* and the species already described in former communications to the 'Annals,' several other interesting forms have been obtained from the shale of the Low-main seam, of which no notice has been given, the most important of these being the following:—

Cœlacanthus lepturus, Ag.

Several entire specimens have occurred, but usually in a much disturbed state. Separate scales are not uncommon.

Strepsodus sauroides, Huxl.

Two or three jaws of this species, with the teeth attached, have been obtained, and numerous separate teeth.

Gyrolepis Rankinii, Ag.

Several specimens have occurred in a more or less complete state of preservation.

Platysomus parvulus (young?).

A few entire specimens have occurred.

Amphicentrum, sp. indet.

Three nearly perfect specimens have been found, and numerous mandibles exhibiting tuberculated plates.

Pleuracanthus lævissimus, Ag.

Several fine, interesting spines, in a good state of preservation, have occurred.

Orthacanthus cylindricus, Ag.

Numerous large well-preserved specimens of this fish-spine have been obtained.

Ctenacanthus hybodioides, Ag.

Five specimens have occurred, in a nearly perfect state of preservation; one specimen is eight inches long.

Leptacanthus, sp. indet.

A spine or two, apparently belonging to this genus, have occurred at Newsham.

Cladodus mirabilis, Ag.

Numerous specimens of the teeth, frequently associated with patches of dermal granules, have been found in several distant localities.

Pleurodus Rankinii, Ag.

Numerous specimens of the teeth have occurred.

Pœcilodus, sp. indet.

Numerous specimens belonging to this genus have been found.

Petalodus, sp. indet.

Several teeth have been procured from the Low-main shale.

Gosforth, Oct. 7, 1868.

XXXIX.—*On the Fin-Whale called "Steypireyðr" by the Icelanders* (Balænoptera Sibbaldii, *Gray*). By J. Reinhardt*.

Since the time when (some twenty years ago) Eschricht's researches on the northern whales had given an impulse to a more accurate study of these gigantic animals, a considerable number of different fin-whales have been stated to inhabit the seas of northern Europe. Hitherto, however, it is chiefly through the differences in their osteology that zoologists have

* Translated from 'Videnskabelige Meddelelser fra den Naturhistoriske Forening i Kjöbenhavn' for 1867, Nos. 8–11.

succeeded in distinguishing these species. About the exterior of the living animal very little is known in most cases, nay, absolutely nothing as far as certain species are concerned. Even the colour of the different species, though so much more easily distinguished and represented than the variations in the external conformation of such huge animals, is still far from being known with the accuracy that might be desired. It is even still undecided to what extent characters can be drawn from the colour of these cetaceans, and at present zoologists seem inclined to consider great differences in this respect to be of little or no importance. This may be shown by a few instances. Thus, when of late years the gigantic fin-whale found near Ostend, and described in the pamphlets and papers of Dubar, Van Breda, and Van der Linden, was considered (and no doubt justly) specifically distinct from *Balænoptera laticeps*, Gray, and called by some *Balænoptera gigas*, by others *Sibbaldius borealis*, the great difference in size seems to have been the principal motive for doing so; and a few years ago a learned cetologist thought himself obliged to grant that the two species just mentioned may still prove identical, without having thought it necessary in settling this question to pay any regard to the difference in their colour. Further, there has apparently been no hesitation in referring fin-whales so differently coloured as the black-and-white male observed in 1841 by Schlegel, and the two more or less grey males described by Companyo and Eschricht, to one and the same species, *Physalus antiquorum*, Gray.

Under these circumstances it happens rather fortunately that the attempts made during the last two years to establish a regular fishery of fin-whales and humpbacks in the sea round Iceland have provided us with some means of answering this question and of forming a tolerably well-grounded idea of the extent of the variations of colour in one species at least; for Mr. S. Hallas, surgeon to the whaler 'Thomas Roys,' has from his cruise of last summer (1867) brought home with him descriptions and measurements of several specimens of that fin-whale which his ship had most frequently fallen in with, viz. the one which the Icelanders call "Steypireyðr;" and his statements have a particular interest, as they furnish us with some useful information about a species hitherto only imperfectly known.

From Mr. Hallas's notes on the different individuals which he had the opportunity of examining closely, it appears that the "Steypireyðr" is a very dark-coloured whale. The upper parts have a blackish-grey colour, in which somewhat lighter stains or specks are sometimes found; down the sides the

colour becomes a little lighter, and that part of the belly which is behind the furrows is uniformly grey; in the anterior plaited region the ridges are blackish grey, but the furrows between them light grey. The caudal fin is blackish grey on both sides, in some individuals also marked with lighter spots in the dark ground-colour. Finally, the distribution of the colours on the pectoral fins is very characteristic: their external surface is blackish grey, sometimes spotted with somewhat lighter specks; the inside, on the contrary, is perfectly milk-white, forming a contrast the more striking, as no other part of the body is of this colour; only just at the base of the fin the white colour changes into a greyish white. Mr. Hallas also found in most individuals some small white linear spots irregularly scattered about the belly; they vary in number and are most probably, as he conjectures, only scars. Leaving these out of consideration, the distribution of the colours is evidently very constant in this species of fin-whale. The only variations which seem to occur are the grey stains that sometimes appear in the darkest-coloured parts of the body, as also in a few cases somewhat darker spots may be found on the grey belly; but these variations are evidently far too small to have any essential effect on the general appearance of the whale. The whalebone seems always to be uniformly black.

Mr. Hallas's notes contain little more than the description of the colour and some measurements. But the latter show that the "Steypireyðr" is one of the largest of the fin-whales. The length of the largest of the six specimens measured is stated to have been 80 Danish feet; the smallest was as much as 70 feet; and though, no doubt, some few feet must be subtracted from each of these figures, Mr. Hallas having measured the distance between the tip of the beak and the notch in the tail not in a straight line, but along the curvature of the back, yet, on the other hand, none of these whales appear to have been quite full-grown, as the coalescence of the epiphyses with the bodies of the vertebræ, Mr. Hallas informs me, was not completed in any of them. It would also appear that the Icelanders are right in supposing that the form of the dorsal fin is a characteristic of this whale, though perhaps they do not give the peculiarities of the fin with perfect correctness when they say that one of the two kinds of *large* fin-whales distinguished by them has a shorter as well as a lower dorsal fin than the other; for the dorsal fin of the "Steypireyðr" seems not to be particularly short; but it is remarkably low, so that its height is contained three times and a half in its length. It was not, in any of the individuals in which it was measured by Mr. Hallas, more than 7 inches high. So incon-

siderable a height of this fin in such an exceedingly large whale is indeed surprising, and affords a useful mark of distinction between the "Steypireyðr" and certain other northern fin-whales, as will appear from the table below, showing the height of the dorsal fin in several of the latter:—

In *B. antiquorum*,	♂,	$40\frac{1}{2}'$,	measured by Schlegel (1841),	$12''$*
„ „	♀,	$37\frac{1}{4}'$,	„ „ (1826),	$10\frac{3}{4}''$
„ „	♂,	$58'$	„ J. Murie (1859),	$14\frac{1}{2}''$
„ „	♂,	$40\frac{2}{3}'$	„ O. Sars (1865),	$13''$
B. Duguidii †,	♀, *c.*	$48'$	„ R. Heddle (1856),	$20\frac{1}{2}''$
B. laticeps,	♀,	$31'$	„ Rudolphi (1819),	$16''$
B. rostrata,	♀,	$25'$	„ Eschricht	$14\frac{1}{2}''$

But, on the other hand, there are also some species, and just those most resembling the "Steypireyðr" in colour, which have a similar low but elongated dorsal fin; and though perhaps, in some of these, differences may yet be found in the shape of the fin, they can scarcely be pointed out from the descriptions at hand. This uncommonly low dorsal fin is also placed unusually far backwards, viz. about the beginning of the last fourth of the body. The pectoral fins seem to present nothing very remarkable in their shape; and their length is contained from seven times and one-fifth to seven times and two-thirds in the total length (measured along the curvature of the back).

The information for which we are indebted to Mr. Hallas thus enables us to form an idea about the "Steypireyðr" satisfactory in certain respects; but, in the present state of our knowledge of the northern fin-whales, it is not sufficient to show quite clearly whether this animal may be referred to any of the earlier observed species or not. It is true that two fin-whales are recorded in cetological literature to which our thoughts will be immediately directed by the description given above, viz. the Greenlandic "Tunnolik," briefly described by Eschricht and H. P. C. Möller‡, and usually considered identical with the Ostend Whale, and the species recently described by Malm under the name of *Balænoptera Carolinæ*§. But these two whales seem to resemble each other, and either of them, again, the "Steypireyðr" so much, as far as the colour is concerned, that, even if it were quite certain that the

* All the measurements of this table are in Danish feet and inches.

† I mention this whale here by the name under which it has been described, without expressing any opinion as to the validity of the species.

‡ K. D. Vidensk. Selsk. Skrifter, ser. 4. vol. xii. pp. 375–380.

§ Malm, A. W., Några Blad om Hvaldjur i allmänhet och *Balænoptera Carolinæ* i synnerhet. Göteborg, 1867. Monographie illustrée du Baleinoptère trouvé le 29 Oct. 1865 sur la côte occidentale de la Suède. Stockholm, 1867.

latter were really identical with one of them, it could hardly be said with which, as long as we had only the description communicated above to go by. To this it must be added that, in spite of the perfect resemblance as to colour, it can at most be probable, but far from certain, that the "Steypireyðr" is really identical with either of the above-mentioned whales, if two cetaceans can exist which, with a striking resemblance in colour, combine such essential differences in their osteology that they must not only be considered as different species, but must even be referred to different sections of the great genus *Balænoptera*,—one, the "Tunnolik," or Ostend whale, to the section of which Dr. J. E. Gray has made his genus *Sibbaldius**, the other, *Balænoptera Carolinæ*, to the genus *Physalus*. There

* In a recently published essay on two subfossil whales discovered in Sweden (Upsala, 1867), my excellent friend Prof. Lilljeborg has established a new genus (*Flowerius*) for the Ostend Whale. Among the characteristics, however, pointed out, the one taken from the position of the dorsal fin is not very well chosen; for when, in the generic character, he writes of the place of this fin as "somewhat in front of the posterior fifth of the entire body's length," this statement may indeed be tolerably correct (provided the measurements given are accurate) as far as the "Tunnolik" stranded at Godhavn (the identity of which with the Ostend whale is by no means proved) is concerned; but it cannot be applied to the specimen which is considered the type of the genus. Nor do I believe that it can be regarded as a certain characteristic, that the atlas "has the lateral processes above the middle and of a conical form," while these processes are "compressed and situated in about the middle of the sides" in *Sibbaldius*. As detailed descriptions of the atlas of the Ostend whale do not exist, and as Lilljeborg has not seen the bone himself, he can only have taken this character from Dubar's figure of the vertebra in his 'Ostéographie' of the said whale; but these figures are too rough to be trusted in this way, more especially as, in the figure of the atlas, the transverse processes are not even represented alike on both sides. Perhaps the left one may arise in the way stated by Lilljeborg; but the right one seems to arise as in *Sibbaldius*, and I do not see how it may safely be inferred from the drawing whether they are conical or compressed. Finally, it is scarcely correct, in the generic diagnosis, to indicate as a character for *Flowerius* that only the second cervical vertebra has annular transverse processes: Dubar, indeed, says so; but it has escaped Lilljeborg that it is stated expressly by Van der Linden, whose essay on the Ostend whale was published later than Dubar's, and is evidently a more trustworthy work, that the third cervical vertebra is provided with annular transverse processes as well as the second. Thus the differences between the genera *Flowerius* and *Sibbaldius* are not even so great as imagined by Lilljeborg, though, if they were, they would not, in my opinion, be sufficient to justify the establishment of a new genus. But, however this may be, there is no need of the name *Flowerius*; for Gray has already, in his 'Catalogue of Seals and Whales in the British Museum' (published in 1866) subdivided his genus *Sibbaldius* into two sections, which he does not, indeed, call genera, but of which the one constituted for *Sibbaldius laticeps* has a special name, *Rudolphius*. If accordingly the genus *Sibbaldius* must be broken up into two, I suppose *Rudolphius* must be adopted for the genus in which the *S. laticeps* is to

might possibly be a third similar species; but even then it would not be certain that the Icelandic whale is a new species; for there is a fin-whale (the *Balænoptera Sibbaldii*, Gray) different from the Ostend whale, and which Malm supposes to be also different from the species described by him, of the *external* characters of which we know nothing, and it is possible that the "Steypireyðr" may be this very species.

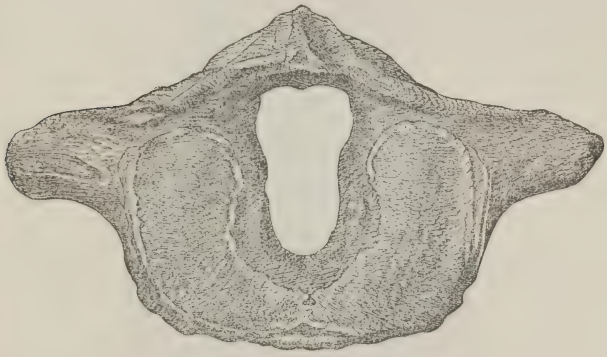
Fortunately, however, we know more than the mere external characters of the "Steypireyðr"; for Mr. Hallas has presented the Zoological Museum of Copenhagen with the hyoid bone and the first cervical vertebra of a male "Steypireyðr" nearly 74 Danish feet long; the Museum has, further, purchased of the Danish Fishing Company the skull of the same individual, wanting only the lower jaw; finally, we have from a third source received trustworthy information about the number of the ribs and the vertebræ: and thus we are in possession of most of the data required to clear away that uncertainty and doubt which could not be removed while we had only the description of the colour and the measurements.

have its place, and the name *Sibbaldius* must be retained for that one the type of which is the Ostend whale.

But, as I before said, these two genera seem to me to be rather superfluous; indeed I should prefer to consider even the best-characterized of the various genera of fin-whales that have been proposed of late only as sections of the genus *Balænoptera* (*Pterobalæna*, Eschr.). Cetologists have gradually gone so far as to make a genus of every well-founded species of fin-whale in our northern seas. Accordingly the generic characters coincide to a great extent with the specific ones; and it is hardly to be expected that those characters the presence of one of which seems now to imply the presence of the other, will also prove to be always connected with each other when we obtain a more accurate knowledge of the fin-whales of the other great seas. In some cases generic characters have also been taken from parts of the organization the value of which as such are at least very doubtful. I mention, as an instance, that one of the generic characters for the genus *Physalus* is taken from the sternum, though, from the observations now before us, it would only seem possible to infer that the shape of this bone varies so much in different individuals belonging to this genus, that it is even doubtful whether it can furnish us with certain specific characters. Even the character taken from the shape of the first rib (whether it is double-headed or not) cannot perhaps in all cases be so thoroughly depended upon as is usually supposed; and it would not be amiss to recall the fact that Eschricht pointed out, more than twenty years ago, that he had found a slight indication of a bifurcation in the upper end of the first rib of a whale which he and, more recently, my distinguished friend Mr. W. H. Flower without any hesitation have referred to *Balænoptera antiquorum*, viz. the whale stranded at Katwijk aan Zee in December 1841, and that he also found the first rib on the left side of an *Orca*-skeleton from Greenland perfectly distinctly forked. Thus the modern genera can hardly be said to be well founded as yet; and as the fin-whales hitherto known are not so numerous that there is any fear of losing a general view of them when they are kept together, there seems at present to be no practical necessity for them.

If we first examine the atlas, it will appear, from the figure given below (fig. 1), that this vertebra presents all the characteristics peculiar to it in the *Physalus* section*, which Mr. Flower first pointed out. Thus the rather long transverse processes evidently enough arise from the upper half

Fig. 1.



Atlas, seen from behind, one-tenth of the natural size.

of the sides of the vertebra; they are somewhat compressed at their base from before backwards, somewhat tapering towards the end, and point straight outwards, except near the very end, which is bent a little forwards. Further, we find, on the posterior surface of the body of the vertebra, not two separate, but only one single, horseshoe-shaped articular surface for articulation with the axis; and, finally, the vertebra wants that median backward-directed triangular process which in the *Sibbaldius* section projects from the under surface of its body, and articulates with a special surface on the second vertebra. The most important dimensions of the vertebra are the following:—

Distance between the extremities of the transverse processes†	30″	2‴
Greatest height of the vertebra	15″	10‴
Height of the neural canal	8″	4‴
Greatest width between the outer edges of the articular cavities for the occipital condyles	15″	6‴
Greatest diameter of each of these articular cavities	11″	9‴
Greatest breadth of the horseshoe-shaped articular surface for the axis	18″	2‴

* Or to the genus *Physalus*, Gray, of 1864, not 1866.

† This measurement is not quite accurate, as the ends of both transverse processes are a little damaged; but the pieces broken off have probably not amounted to more than an inch on either side.

In the skull (see fig. 2) the characters distinguishing the

Fig. 2.

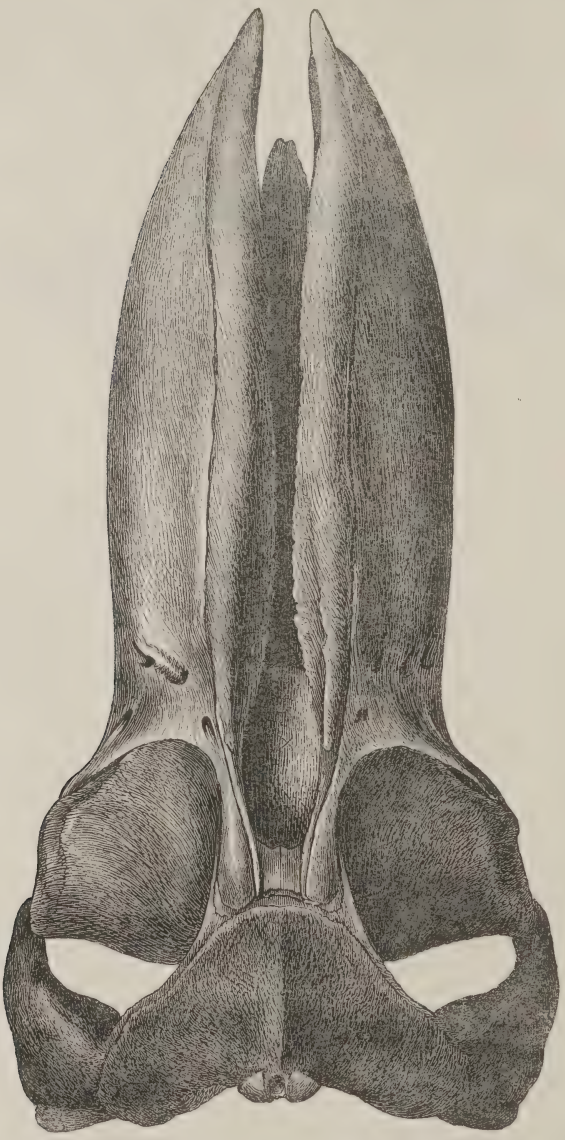
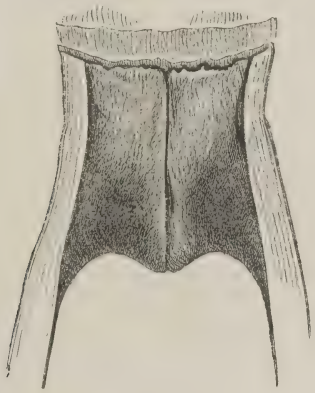


Figure of the Skull, one thirty-sixth of the natural size.
At × a piece of the great cartilage which originally filled the whole cavity of the vomer is still seen.

Physalus section are no less strikingly developed. Especially the orbital process of the frontal presents exactly the form peculiar to this section, being not only very short in the transverse direction of the head, but also nearly twice as broad near its base as along its external border, tapering therefore very much in an outward direction. The same is the case with the nasal bones, of which a figure nine times diminished is given beneath (fig. 3), though, indeed, in a point of minor importance they

Fig. 3.

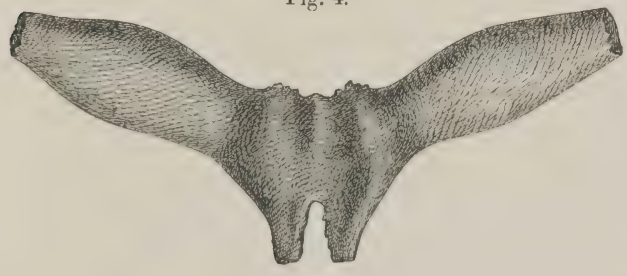


Nasals.

appear to deviate a little from those of *Balænoptera antiquorum*, the only species of this section in which they have hitherto been described and figured with accuracy. They are rather short, and deeply hollowed on the anterior edge and anterior part of their superior surface, so that an obtuse ridge is formed along the middle line, projecting forwards in a roundish point, as in the species just mentioned; but at the same time there is less difference in their breadth before and behind than in the latter.

The hyoid, finally, indicates the same section, as will be seen

Fig. 4.



Hyoid.

from the figure representing this bone (fig. 4) seen from the concave upper surface, one-eighteenth of the natural size. Unfortunately the stylo-hyals, which sometimes seem to afford valuable specific characters, are wanting.

The results to which we are led by examining the skull, the atlas, and the hyoid are moreover corroborated by the information received from Capt. Bottemann about the number of the ribs and of the vertebræ; for this gentleman, who last summer (1867) was occupied at the fishing-establishment at Seidisfjord, on the east coast of Iceland, counted sixty-four vertebræ in the skeleton of a full-grown "Steypireyðr." He found, further, fifteen pairs of ribs in a fœtus about 18 feet long, which he had an opportunity of examining more minutely on the 2nd of September, and of which he has been kind enough to send a sketch, accompanied with numerous measurements. Accordingly, though important diagnostic parts of the skeleton (viz. the lower jaw, the first rib, and the sternum) have not been examined, yet it may be considered certain that the "Steypireyðr" belongs to that section of fin-whales for which the *Balænoptera antiquorum* may be taken as the type, or, in other words, to the genus *Physalus*, Gray, 1864 (not 1866).

But it is equally certain that it is a species not less distinct from the typical one as to its osteology, and especially as to its skull, than we know it to be as to its external characters. When we compare one or another of the better figures of the skull of the type with that of the "Steypireyðr" (fig. 2), it will immediately be seen that the principal difference is that the beak (or, in other words, that part of the face which is situated before the orbital or zygomatic processes of the maxillaries) is much broader and much more obtuse in front in the "Steypireyðr" than in *Balænoptera antiquorum*, and that the outer borders of this part of the skull run almost parallel in their posterior half, and only begin to curve towards each other beyond this point. But this, on the other hand, is a diagnostic character of the skull of *Balænoptera Sibbaldii*.

An additional resemblance to the latter species is further presented in the orbital processes of the frontals, whose breadth at their base is considerably greater than their length in the transverse direction of the skull. A pervading resemblance to this species in almost all the proportions of the skull will easily be proved by the table below, giving the measurements of the skull of the "Steypireyðr" taken exactly as Mr. W. H. Flower measured the skull of *Balænoptera Sibbaldii* formerly belonging to Lidth de Jeude; in which, further, the corresponding measurements of that skull are

	Steypireyðr.	*B. Sibbaldii.*	*B. antiquorum.*
Length of the skull *	205	118	184
Breadth of the occipital condyles	17	15	12
Greatest breadth of the occipital bone	65	36	56
Greatest breadth of the skull (across the zygomatic processes of the temporals)	99¾	60	96
Distance from the occipital foramen to the anterior edge of the occipital	38¼	27	41
Length of the orbital process of the frontals (in the transverse direction of the skull)	31	19	32
Breadth of the orbital process at base	39¾	22	34
Breadth of the same along the upper surface of the outer end	20	13	18
Length of the nasals (along the median suture)	9¼	6½	8½
Breadth of both the nasal bones at the posterior end	7½	5¼	6
Breadth of the same at the anterior end	9½	6	9¼
Length of the beak	133½	73	133
Length of the maxillaries	159	86	145
Projection of intermaxillaries beyond maxillaries	7¾	5	9
Breadth of the maxillaries at hinder end	19½	15	17
Breadth of the same across the orbital process	88	—	—
Breadth of the same in the same place, following the curve	103½	64	89
Breadth of each of the maxillaries in the same place	33½	—	—
Breadth of the beak at its base	60½		
The same, the curve included	67	—	45
Breadth of the maxillary in the same place	18½		
The same, the curve included	20	13¼	13½
Breadth of intermaxillary in the same place	9½	3	6
Breadth of beak in the middle	61½	—	—
The same, the curve included	64	32	33
Breadth of the maxillary in the same place	20	11	9½
„ „ intermaxillary in the same place	9½	4	5½
„ „ beak at three-fourths of its length from the base	45¾	—	—
The same, the curve included	49	22	18½
Breadth of maxillary in the same place	10	5½	5
„ intermaxillary in the same place	8¾	4½	3½

* The measurements of the Icelandic cranium are given in Danish inches, but those of the other two in English inches. As the question is only about the relative dimensions, I have considered it unnecessary to transfer the English to Danish measurements. They are taken in a straight line when the contrary is not stated expressly.

added for comparison, and also the measurements of the skull of a large *Balænoptera antiquorum* in the zoological garden at Antwerp—both taken from a table communicated by the above-mentioned English cetologist in his valuable "Notes on the Skeletons of Whales"*. The little discrepancies which may be found in some few relative dimensions can hardly have any importance when we consider that the skull of whales changes considerably during growth, and that the Icelandic cranium is not very far from being twice as large as the one described by Flower.

To this almost perfect resemblance in the skull we must further add a correspondence in the colour of the baleen, which is uniformly black in the Icelandic whale, as is also that of the *Balænoptera Sibbaldii*, and, finally, according to the statement of Capt. Bottemann, a correspondence as to the number of the vertebræ, so much the more important as sixty-four vertebræ is the greatest number yet met with in any fin-whale†, and is only found in the above-mentioned species‡. Accordingly I do not hesitate to refer the "Steypireyðr" of the Icelanders to *Balænoptera Sibbaldii*; and as we hitherto have only known the skeleton of half-grown specimens of this whale, the knowledge of it has been not a little promoted by the information now procured.

This result established, we have still to find out what the relation of this species is to the two other fin-whales, to which it bears such a striking resemblance in colour that it seems impossible to point out any essential difference, viz. the species recently described under the name of *Balænoptera Carolinæ*, and the "Tunnolik" of the Greenlanders, usually considered identical with the Ostend whale.

As to its relation to *Balænoptera Carolinæ*, I see, from a short notice in the English periodical the 'Athenæum' (1868, No. 2108, p. 427), that Mr. W. H. Flower, at the meeting of

* Proc. Zool. Soc. of London, Nov. 8, 1864, p. 411.

† In the essay of Eschricht and myself on the Greenland whale (in the K. D. Vid. Selsk. Skr. ser. 5. vol. v.) the number of the vertebræ in *B. antiquorum* (*B. musculus*), p. 549, is, by a misprint, stated to be 63; and the same error appears also in the English translation of the same essay in the "Recent Memoirs on the Cetacea," edited by W. H. Flower for the Ray Society (p. 105). I consider it my duty to correct this error, so much the more as I perceive with regret that others have been led astray by it. The *Balænoptera antiquorum* has regularly only 61 vertebræ, and that is also the number found in the skeleton alluded to by Eschricht and myself in the treatise quoted above.

‡ One of the two skeletons on which this species has been founded is known to have sixteen pairs of ribs, the other fifteen. As Mr. Bottemann only found fifteen in the fœtus dissected by him, it is probable, though by no means certain, that the latter number is the normal one.

the Zoological Society of London on the 12th of March, communicated some remarks on Mr. Malm's new species, suggesting that the latter would most probably prove identical with *Balænoptera Sibbaldii*. I think this supposition to be highly probable; and to the reasons for it (which, I suppose*, Flower has taken from resemblances of the skeletons) we must now also add the remarkable correspondence in colour, the peculiar low dorsal fin, and, finally, the backward position of this fin, just before the posterior fourth of the animal. Yet I must confess that I have not succeeded, by the assistance of Mr. Malm's description and measurements of the skull, in entirely convincing myself that the latter has the same broad beak by which the *B. Sibbaldii* is at once distinguished; and it is to be regretted that Malm has given no figure of the cranium that might assist his description, and which I am sure most zoologists, if they had been allowed to choose, would have much preferred to several of the illustrations (of rather doubtful scientific value) with which his work is so abundantly provided. Nor must it be overlooked that Malm, who has had an opportunity of comparing in detail his own whale with a skeleton of *B. antiquorum*, and who in general is very minute in pointing out the various more or less weighty reasons which have induced him to consider it a species different from the latter, does not make one word of allusion to any difference in the form of the cranium; and yet it would be thought that if the skull of his whale had resembled the illustration here given (fig. 2), such a peculiar form could not have quite escaped his attention. But we know, on the other hand, that even the two specimens of *Balænoptera Sibbaldii* on which the species is founded differ somewhat from each other as to the breadth of the beak, and it appears that in *Balænoptera antiquorum*, too, the breadth of this part varies in the different specimens†. Thus it may be that the diagnostic character afforded by the beak has not been so strongly developed in Malm's whale as in the Icelandic cranium, and so might the more easily have been left unnoticed; and though I have not ventured to suppress this little difficulty which may possibly still be found in Flower's view of the matter, yet his supposition is, after all, much more probable than that two species of finwhales resembling each other so closely in most respects, and yet specifically distinct, should exist in the northern seas.

* I regret that I have not yet had an opportunity of becoming acquainted with Mr. Flower's paper itself.

† Mr. Flower states that in six crania of *Balænoptera antiquorum* the proportion of the breadth across the middle of the beak to the length of the skull was found to vary between 18 and 21 to 100. (See Proc. Zool. Soc. of London, 1865, p. 473.)

Now, as to the "Tunnolik" of the Greenlanders, it must be admitted that if this really is identical with the Ostend whale, as has hitherto been usually supposed, it must, no doubt, *as science stands at present*, be considered a species quite distinct from the "Steypirey ðr" or *Balænoptera Sibbaldii*. But the question is, whether this supposition is true; and though with respect to this whale we are still limited to the very same materials that were formerly at Eschricht's disposal, yet they may be found sufficient to answer this question. What made Eschricht suppose that his "Tunnolik" might be the same species as the Ostend whale was the resemblance which he found between Dubar's figures of the pectoral fin of the latter and the fin which Mr. Möller sent him from Greenland*. Now this correspondence is so great, indeed, that at a time when only a single fin-whale with such a pectoral fin was known, he surely was justified in making such an inference and in disregarding the discrepancy that seemed to exist as to the place of the dorsal fin, and to explain it as caused only by a mistake in the measurement of one or other of these two whales, which had taken place under very unfavourable circumstances. But the matter appears in another light now that a pectoral fin, like that of the Ostend whale, characterized by the uncommonly elongated and slender form of the phalanges, is found also in the *Physalus* section.

The pectoral fin of the skeleton of *B. Sibbaldii* which originally belonged to Lidth de Jeude is stated by Flower to have four phalanges in the index, five in the third finger, five in the fourth, and three in the fifth; the fin of the skeleton at Hull agrees with this, except that the third finger has six phalanges†. It is, however, observed expressly by Flower, that, the phalanges of both skeletons being artificially articulated, we cannot be sure that they are arranged in their natural order of succession, or that they are all present; Eschricht found, indeed, when he examined the skeleton at Hull in 1846, seven phalanges in the third finger, or one more than Flower‡. Accordingly one phalanx seems to have been lost during the time that has elapsed since Eschricht had an opportunity of studying this skeleton. Thus it becomes very probable that the still smaller number of phalanges in

* See K. D. Vid. Selsk. Skr. ser. 4. vol. xii. (1846) pp. 379, 380, and ser. 5. vol. i. (1849) p. 138.

† Proc. Zool. Soc. London, 1864, p. 413, and 1865, p. 473. The metacarpal bones are not included in the number of the phalanges in these statements; and the same is the case in all the following statements where nothing is said to the contrary.

‡ K. D. Vid. Selsk. Skr. ser. 5. vol. i. p. 130.

the same finger, of the skeleton formerly belonging to Lidth de Jeude, is only a consequence of an injury; and the number of the phalanges of the four fingers in *Balænoptera Sibbaldii* may be stated to be either 4, 7, 5, 4 or (perhaps) 4, 7, 6, 4.

When, now, we compare with these the number of the phalanges in the pectoral fin of the "Tunnolik," I must first remark that the figure of the latter given by Eschricht is not quite correct; nor is his statement in the text of the number of the phalanges* perfectly accurate or quite in accordance either with the actual conditions or with the figure†. It is much to be regretted that this pectoral fin, which, at the time when Eschricht received it, was quite complete, has afterwards suffered some damage: the tips of the fourth and fifth fingers are lost, and there are now only four phalanges in the first, and two in the second, of these two fingers. It is therefore impossible to state exactly how great the error in Eschricht's figure really is; but there are certainly only four phalanges in the second finger (the index), and but six in the third; and though the fourth finger, as I have said, is incomplete now, and the original number of the phalanges cannot be stated, yet it may at any rate be positively inferred, from the form and length of the remaining part, that it was never so long as the third: therefore the woodcut in Eschricht's memoir is incorrect in representing it as being even a little longer than the latter; but what the cause of the mistake really is, whether the artist has drawn too many phalanges, or made the phalanges really existing too long, must be left undecided. The formula for the number of the phalanges in the hand of the "Tunnolik" will therefore be 4, 6, 6 (?), 3 (?); and as the woodcut cannot be thoroughly depended upon as to the comparative size of the single phalanges, I here add the measurements of the hand in Danish inches:—

	Length.	Breadth in the narrowest place.
Second finger—		
Metacarpal	$10\frac{1}{6}$‡	$3\frac{2}{3}$
First phalanx	$10\frac{1}{2}$	$2\frac{1}{12}$
Second ,,	8	$1\frac{1}{2}$
Third ,,	$5\frac{2}{3}$	1
Fourth ,,	$3\frac{1}{4}$	$\frac{1}{2}$

* Besides the metacarpal bones, 5, 5, 6, 3.

† K. D. Vid. Selsk. Skr. ser. 4. vol. xii. p. 382.

‡ The measurements are only taken from the osseous phalanges; the cartilages between them are, as usual, not included.

Table (*continued*).

	Length.	Breadth in the narrowest place.
Third finger—		
Metacarpal	13	$3\frac{1}{12}$
First phalanx	11	$2\frac{2}{3}$
Second „	$7\frac{3}{4}$	$2\frac{1}{3}$
Third „	$5\frac{1}{2}$	$2\frac{1}{12}$
Fourth „	$3\frac{1}{2}$	$\frac{11}{12}$
Fifth „	$5\frac{1}{6}$	$\frac{2}{3}$
Sixth „	$3\frac{1}{2}$	$\frac{5}{12}$
Fourth finger—		
Metacarpal	$9\frac{1}{2}$	$2\frac{3}{4}$
First phalanx	$8\frac{5}{6}$	2
Second „	7	$1\frac{1}{2}$
Third „	5	$1\frac{1}{6}$
Fourth „	$2\frac{1}{2}$	$\frac{3}{4}$
Fifth „	?	?
Sixth „	?	?
Fifth finger—		
Metacarpal	$6\frac{1}{4}$	$2\frac{3}{4}$
First phalanx	6	$1\frac{1}{4}$
Second „	$3\frac{3}{4}$	$1\frac{1}{2}$
Third „	?	?

From these statements it appears that the hand of the "Tunnolik" may quite as well have belonged to a *B. Sibbaldii* as to *B. gigas*, for a single phalanx more or less in a finger is of no great importance in the whales; and if it be further considered that the colour of the "Tunnolik," as described by Möller in the account sent to Eschricht, as well as the place occupied by the dorsal fin, according to his statement, seem to be much more characteristic of *Balænoptera Sibbaldii* (as we now know it) than of the Ostend whale, it will certainly be admitted that there are good reasons for referring the "Tunnolik" to the former, and not to the latter species. It must be allowed that the description given by Eschricht of the dorsal fin of his "Tunnolik," according to which it should be only 4 inches high, and placed upon a thick knob ("Fodstykke," base of the fin, as it is called by Eschricht), is not in accordance with what we know of this fin in *B. Sibbaldii*; but it agrees no better with that of the Ostend whale, nor, indeed, with the dorsal fin of any known fin-whale. To me this strange form appears rather to have been a monstrosity; and it is to be regretted that Eschricht has not accompanied

his description with a drawing, and that the fin itself which Möller had sent him has not been preserved.

If the result I think we have come to is correct, *Eschricht's "Tunnolik," the "Steypireyðr" of the Icelanders, and, finally, the whale described by Malm are only one and the same species*, which appears to be one of the most common in our northern seas, and the systematic name of which must be *Balænoptera Sibbaldii**. If, contrary to expectation, it should appear, after all, that *B. Carolinæ* is different, I do not think it possible, from the materials now available, to state with certainty whether the "Tunnolik" in that case must rather be referred to the one or to the other of these two species; but, as I have said, there is scarcely any fear that this question will be raised.

I have still to add some measurements taken by Capt. Bottemann, apparently with very great care, of the male fœtus of the "Steypireyðr" mentioned before in this notice. He has been kind enough to send these to the Museum at

* In his elaborate Monograph of the *Balænoptera Carolinæ*, p. xxi, Malm alludes to the possibility that his whale might be identical with *B. Sibbaldii*, remarking that, even if it were so (which, however, he denies), he could not use the name *Sibbaldii*, because "it has already been used by Neill in 1808 for another fin-whale, *Musculus Sibbaldii*, Neill." This, however, is a complete misunderstanding, which shows that Malm cannot have seen, much less read, Neill's paper on the whale stranded near the town of Alloa, but must have quoted at second hand from Eschricht's Schema A, in his sixth essay upon the Cetaceans (K. D. Vidensk. Selsk. Skrifter, ser. 5. vol. i. p. iii), or perhaps from the corresponding schema in the same author's 'Zoolog. Untersuchungen über die nordischen Wallthiere.' It is true that the whale was stranded in 1808; but Neill's paper was not read in the Wernerian Society till 1809, and not printed till 1811; and then, Neill does not give the Alloa whale any new name, but considers it to be the same species as that which was stranded in 1690 on Burntisland, and which Sibbald, in his 'Phalainologia Nova' (ed. 2, p. 69), thought to be identical with the *Musculus* of Pliny. Purposing to point out, in the schema mentioned above, the specific identity between the Alloa whale and Sibbald's "*Balæna tripinnis quæ rostrum acutum habet*," Eschricht has briefly expressed this in the words "*Musculus Sibbaldii*," or the whale denoted by Sibbald as "*Musculus*;" and this denomination was not understood by Malm. Of course it is not my intention to reproach Malm in the least for having been unable to examine the paper of Patrick Neill; but I think it would have been more correct to have stated expressly that his was a second-hand quotation. And even if Malm had never seen the notice in question, he would, by a more judicious use of the remaining zoological literature, have been saved from falling into the singular mistake that Neill had in 1808 established a fin-whale genus *Musculus* and a fin-whale species *Musculus Sibbaldii*.

Copenhagen; but unfortunately I am unable to state whether Danish or foreign measures have been employed.

	feet.	inch.
From the tip of the beak to the hindmost end of the blowers	3	0
„ „ „ „ the dorsal fin	12	10
„ „ notch of the tail	17	1
From the tip of the beak to a line supposed to be drawn between the points of the flukes of the tail	18	1½
From the notch in the tail to the anus	5	3
„ „ „ penis	6	5½
„ „ „ umbilical cord	7	5½
From the tip of the beak to the pectoral fin	5	0
„ „ eye	3	0½
„ „ ear-opening	4	1½
Length of the blowers	0	5½
Distance between the blowers behind	0	3½
„ „ in front	0	0¾
Length of the dorsal fin along the back	1	0
Height of the dorsal fin	0	4½
Length of the pectoral fin	2	9
Greatest breadth of the pectoral fin	0	9
Distance between the points of the flukes of the tail	3	3
Girth of the head in the middle between the eye and the ear-opening	7	2½
Girth of the body across the pectoral fins	7	0
„ at the umbilical cord	6	6
„ „ penis	5	5½
„ „ anus	4	7
„ just before the tail	2	2
Perpendicular diameter of the body at the pectoral fins	2	8
The same, at the umbilical cord	2	5
The same, at the anterior edge of the dorsal fin and anus	1	9½
The same, at the posterior edge of the dorsal fin	1	7
The same, at the base of the tail	1	0
Number of furrows in the belly between the pectoral fins	66	
Ditto beneath the place where the ear-openings are found	82	

XL.—*Notes on the* Lodoicea sechellarum, *Labill.* By Edward Perceval Wright, M.D., F.L.S., Professor of Zoology, Trinity College, Dublin.

In June 1867 I was invited, by Swinburn Ward, Esq., H.M. Civil Commissioner for the Seychelles Islands, to accompany him on a tour of inspection around the Island of Praslin. I was at that time engaged in exploring the forests of Mahé, the largest and most populous island of the group; but anxious to visit the native island of the well-known "Coco de mer," I at

once accepted the invitation, and prepared to spend two or three weeks on Praslin. As we glided gently through the passage in the coral-reef that runs along the eastern coast of Praslin, the first object that met my view was a clump of the *Lodoicea sechellarum*; there were four or five trees, growing erect and to a height of about forty feet, from between a mass of granite boulders quite close to the sea-shore.

To study the structure of this noble palm-tree, to find out all I could about its life-history, to ascertain the probable rate of growth of its stem, the duration of its flowering period, and to bring back with me to Europe young growing plants were some of the chief objects of my visit to this group of islands.

For centuries the history of this palm had been involved in mystery; its strange-shaped nuts had been now and then found washed ashore on the Maldive Islands or floating about on the surface of the Indian Ocean; but its native country, or what kind of tree it was that produced such nuts, was unknown. Tradition said it was a production of the sea. Rumphius believed in tradition, and assures us that it is not the product of a terrestrial plant that had fallen into the sea, but a veritable marine fruit; and sailors who never heard of Rumphius told strange stories of the tree itself growing beneath the salt water, with large bunches of the double cocoa-nuts hanging from its branches; but when they would dive to gather the nuts, the nuts and the tree and all would disappear. Of course, if this were true, there was little chance of the double cocoa-nuts becoming common; and so the few that were found floating were sold for very enormous prices; those that landed on the Maldive Islands were the property of the king, who had a very severe law of "treasure trove," by which it was enacted that the person finding these nuts and not bringing them to the king should be put to death.

The discovery of the Seychelle Islands by Captain Lazare Picaults, of the 'Elisabeth,' despatched on a voyage of discovery from the Isle of France by M. Mahé de Labourdonnais, set the question of the native country of the double cocoa-nut at rest, and determined the fact that they were the products of a gigantic palm-tree. Sonnerat, in his 'Voyage to New Guinea,' gives a description of this tree, which he found on Praslin. Commerson described it in MS. under the name of *Lodoicea*; and La Billardière, in the 'Annales du Muséum d'Histoire Naturelle,' gave a botanical description of it, accompanied by figures drawn from spirit specimens of the fruit, and a drawing of the tree from nature by M. Lilet. M. Quéau de Quincy appends to this paper some remarks on the economic value of

the palm. This M. de Quincy was the last administrator of the king of France. He was then named military commandant and civil agent for the French republic; and having in May 1794 surrendered to the summons of Capt. Newcome, of H.M. frigate 'Orpheus,' he was appointed acting commissioner to the English government, which position he occupied at his death. He is buried on the summit of a little knoll not ten minutes' walk from Government House; and by his tomb, of white coral, the English flag is hoisted on all holidays and fête-days throughout the year.

Some few years more elapsed until Mr. Telfair, a gentleman well known in connexion with the botany of the Mauritius, obtained specimens of the male and female fruit, and forwarded them to Sir W. J. Hooker, then Regius Professor of Botany in the University of Glasgow, whose account, in the first volume of the new series of Curtis's 'Botanical Magazine' (1827), leaves very little indeed to be added to the general description of the palm (plates 2734–2738).

Since then, Dr. Barnard and my friend Mr. Swinburn Ward have published contributions to the history of the palm.

We landed on the eastern side of Praslin; and while the seine-net was being dragged to provide us with some fish for breakfast, I walked to the place where I had seen the *Lodoicea*. Passing along by the sea-side, I found the sandy beach strewed with innumerable flowers of *Barringtonia*——?; fringing the sea, and in many places growing in it, was a species of *Scævola*. The double-cocoanut trees were all male plants; the ground at their feet was covered with the remains of the long catkins, crumbling into dust when touched. The trees appeared to grow almost out of the rock, and the little earth seen near the roots was a tenacious yellow clay. Two, and sometimes three, leaves hung suspended from the stem. In the distance, along the coast and up the mountains' side, I saw other specimens; but they were but thinly scattered along this eastern side of Praslin. I had, however, other and better opportunities of seeing and examining much finer specimens than are to be met with on this side of Praslin, and I hope, in a small work which I am at present engaged in writing, to give an account at some length of the *Lodoicea*, and to accompany the chapter on this subject with a figure thereof from a photograph, and with illustrations of the ripe nut and sections of the stems of both young and old trees. In these notes I purpose only to give, as briefly as possible, an account of the *Lodoicea*-forests of Praslin and Curieuse, to state the facts that I have collected that bear on the question of the age of the

trees, and to conclude with a few words on the introduction of this palm into Europe. In March, 1864, Sir W. J. Hooker read to the Linnean Society extracts from a letter from Mr. Swinburn Ward relating to the Coco de mer, which concluded with the statement that "not many years will elapse before the Coco de mer becomes in reality as rare as it was supposed to be when picked up at sea by the wondering mariners; and the only relics left of its former magnificence will be the decaying stumps of the trees, so wantonly destroyed, and the curious sockets in which they stood for so many years." This statement naturally alarmed all botanists; and, at the request of the Linnean Society, Mr. Ward kindly visited both Praslin and Curieuse for the purpose of examining into the subject a little more closely, and came to the conclusion that, although many hundreds of this palm-tree had been destroyed on the north-west of Praslin, yet that several large forests still remained, and that the tree was not at all likely to become extinct.

The island of Praslin lies nearly north-west and south-east; a range of mountains, some 1500 feet in height, runs from one end to the other of the island. It is several miles broader on its south-eastern than on its north-western side; and here there is a large deep bay, in the mouth of which stands a little island, called Isle Ronde. On the eastern side of Praslin lies Isle Curieuse, separated from Praslin by a strait from half a mile to a mile in width. In the midst of the mountain-range on Praslin there are several deep valleys, where for the most part the indigenous flora is still untouched. It would appear that the *Lodoicea* is indigenous on Curieuse, Praslin, and the little Round Island, and that wherever else it is met with on the Seychelles it has been planted by the hand of man. On Isle Ronde only two or three are to be met with. On Curieuse, which is government property, a large number of trees are to be found, chiefly on the northern side of the island. On the southern side the soil is very poor, and there is but little of it (for, the underwood here having been destroyed, the soil has been to a great extent washed away), and the *Lodoicea* grows to a height of not more than from ten to twelve feet; on the northern side, however, there are some very fine trees. This island is the seat of a leper-establishment, perhaps the only one ever supported by the British Government. It would appear that, shortly before the passing of the Act for the emancipation of slaves in the British Colonies, it had been represented to the then Ministers of the Crown that very many unfortunate lepers were living in a state of utter destitution on many of the smaller coral islands so numerous in the Indian Ocean.

All, or at least the great majority, of these had been conveyed to, and abandoned on, these islands by their masters, who thought in this way to stop the spread of leprosy among their gangs of slaves. The first effect of these representations was the selection of the Isle Curieuse for a leper-establishment, and the building of two leper-camps on its western side, at a place well sheltered, and where a little stream runs down into the sea—that on the right side of the stream for the male, and that on the left side for the female lepers. Thither, in October 1829, George Forbes, an active and intelligent native of Scotland, being appointed as overseer, proceeded, bringing with him one leper. In a very short time afterwards the brig 'Hebe,' having visited the different islands inhabited by lepers, arrived off Curieuse and landed some two hundred more. In Mr. Forbes's letters of instruction, special directions are given not to permit the leaves of the Coco de mer to be cut, or the nuts to be eaten; and he is desired to plant, once a month, all mature nuts found on the ground, at a distance of ten paces from each other. Boats were forbidden to land, unless in charge of some responsible officer. The lepers were not allowed to leave the island. All fish and turtle caught were to be divided; but it was forbidden to eat the tortoise-shell turtle, though its shell was to be sent to the Governor. Sardines were not to be eaten until their heads were taken off and they were well cleaned; and, lastly, Mr. Forbes is urgently admonished to be kind and forbearing to the unfortunate beings placed under his care.

It is interesting to read over these instructions, and to see that even then care was taken to preserve the Coco de mer; but as I perceive, from the date of the letter of instruction, that Sir W. J. Hooker's letters and description of the palm would have reached the islands just at this very time, I do not think I am far wrong in ascribing this care, in a great measure, to a desire to meet his wishes; and here I may add, on the testimony of several Civil Commissioners, and as the result of my own experience (for, as Acting Government Medical Officer, I had the care of Isle Curieuse), that from 1829 until the present time, for now nearly forty years, Mr. Forbes has acted up to the spirit as well as to the letter of his instructions, both as regards the beautiful palm-tree and the disease-stricken inhabitants of the island. As this island is still government property, we may be sure that as long as it keeps its head above the encroaching waters of the Indian Ocean, it will remain the home, as it is the cradle, of this species.

It is, however, in Praslin that the *Lodoicea* is to be seen in all its glory. Perhaps the forest easiest to visit is that on

the south-eastern side of the island, the property of Mr. Campbell; here the trees grow in great numbers, down even to the water's edge. The largest (some are from 100 to 130 feet high) are met with in the valley. Male and female trees are found in nearly equal quantities. On this property a certain number of the trees are stripped of their leaves to supply the demand for this article at Mahé, where they are manufactured into hats, fans, and baskets. A certain number of nuts are allowed to remain on the ground to germinate, and, besides these, a large number fall that are never found; and a good number are sent to Mahé and to the Mauritius for sale. But unless some sudden catastrophe happen to this forest, which contains many thousand trees of all sizes and ages, it will long remain a sight well worthy of being visited by the curious.

Another, and to my mind more magnificent, forest of this palm is to be met with in a large valley situated in the mountains between the cocoa-nut plantation on the eastern side, over which Mr. Osucree is the agent, and the Protestant schoolhouse and church on the western side. A walk of some two hours from the worthy and hospitable agent's house brings one to the summit of the mountain, and then this noble valley bursts upon one's view; but in the space I allow myself for these notes I cannot do justice to this subject. The valley may be, in its narrowest portion, about a mile wide and some 500 feet deep; in its centre a little rivulet commences, that meanders through a narrow valley looking towards the north-west. Here were to be seen hundreds of *Verschaufeldia grandiflora* and a *Stevensonia*, growing to a height of thirty to forty feet. In sheltered nooks there were groves of a tree fern, with stems fifty feet in height; but towering like giants among these pigmies were very many (too many to count) of the *Lodoicea sechellarum*, often growing in threes—two female trees, and between and somewhat overshadowing them a male tree. They were from 100 to 150 feet in height, and were in all stages of fruit and flower. The spathe of the male spadix is smaller than the spathe of the female spadix; and the latter, by the time the fruit ripens, becomes very hard and spike-like. It is this portion that the creoles allude to when they tell one that "the fruit-stalk is supported by three strong bracts, the outer one of which penetrates the stalk immediately above it, in the underside of which nature has left a fissure accessible to it: by this provision the stalk is enabled to support the weight of fruit which hangs on it" *. I found, on all the trees that I

* Journal of the Linnean Society, vol. viii. p. 137. Of course I do not ascribe this theory to my friend Mr. Ward, although I here quote from his interesting paper.

examined, a parenchymatous barky layer, that in trees that had fallen for some time was easily peeled off. This barky layer was very curiously pitted; this pitting was caused by the intrusion into the parenchymatous layer, and piercing through it, of the woody fibres of the stem; but without illustrations it would not be easy to explain this structure, and I must therefore reserve it for another occasion. Some of the so-called "bowls" were met with on the mountain-slopes: here I need only add that sections made through both young and old trees revealed no peculiarity of structure in this portion of the stem other than what is met with in almost all palms.

From an examination of all these forests, I arrived at the conclusion that the growth of the stem depended very much on the soil in which it grew; and I was pleased at being able to determine this by the following facts. Many nuts have been planted on Isle St. Anne, in different parts of Mahé, and at Silhouette, and the date of the planting of these nuts is in many cases known with great accuracy. Thus Mr. Charles Savi planted some seven or eight at Silhouette in one long row, some twenty feet apart, on the side of a mountain, but only some two or three feet above high-water mark; the nuts were planted at the same time, in the year 1812. Of these, some six germinated, and for the first year or two grew without one showing any great advantage over the other; now, after the lapse of fifty-six years, three of these trees (two females and one male) measure four feet in diameter at the base of their stem, which is twenty-six feet in height, and they bore their first fruit and flowers in the year 1851, when they were, as nearly as possible, forty years old: the other three are to this day without *stems*, and have borne neither fruit nor flowers. At first, recollecting the result of recent researches into the arrest of development of the axolotl, I thought here might be a similar case among plants; but on a little investigation I found that the thriving Cocos de mer had fallen upon good ground, where they could grow abundantly, and that the others had fallen upon poor, stony soil, where the puzzle was to find from what they did get sufficient food to keep them alive now these fifty-five years. Many other facts like this I could quote; but sufficient has been said to show the danger of drawing conclusions as to the slow growth of trees from their slowness of growth under cultivation: and this leads me to say a few words as to my hopes of introducing these trees into this country.

I brought with me, in December 1867, to Alexandria, three young trees, about three years old, of this palm. The weather was too cold at this period of the year to permit their being

brought either to Paris or Kew; and I left them in the care of my good friend Mr. Calvert, H.B.M. Vice-Consul at Alexandria, well known as an excellent botanist, who gave them to that excellent horticulturist Herr Winterstein to keep during the winter. Unfortunately these trees did not survive; but, thanks to M. Adrien, of Isle Praslin, and Mr. Ward, I hope in spring next, when the weather becomes a little warm, to receive some young plants which have been germinated in tubs, and which will thus not have had the risk of being transplanted. These I shall hand over, when they arrive, to the gardens of Kew and Dublin; and I have no doubt they will be well taken care of.

In some of the volumes of Curtis's 'Botanical Magazine,' excellent hints on the cultivation of plants will be found, given by Mr. John Smith of Kew. It would be well for our plant-growers if they would oftener read through and digest these articles. In treating of the cultivation of *Lagetta lintearia*, Lam. (tab. 4502), he remarks on the hints given to him for his guidance in growing this plant by Mr. Wilson (who found the plants growing on their native soil):—"We are always most desirous to pay attention to information as regards the native habitats of plants; but in cases like the present we have found that when too strictly adhered to, successful cultivation does not always follow. In our experience we have never found any plant thrive by retaining it in its native soil. If we could only imitate all the various influences of climate that modify and control the growth of plants in their native localities, then we might do so." These very correct remarks it will be well to bear in mind when the time comes, as I hope it will soon, for us to cultivate this fine palm in our stoves; for most certainly the *Lodoicea* will not grow under cultivation in the Seychelles Islands, when planted in rocky, stony ground such as the trees are found to flourish in in their native forests of Praslin and Curieuse, and yet there there is no necessity to imitate the climate: how much less, therefore, will it grow with us, if subject to the same treatment, when with us it would seem practically impossible to imitate the alternate wet and dry seasons of the tropics!

XLI.—*Notes on the Distribution in Time of the various British Species and Genera of Graptolites.* By Henry Alleyne Nicholson, D.Sc., M.B., F.G.S.

Speaking generally, the Graptolitidæ may be said to be characteristic fossils of the Silurian period; and the generaliza-

tion of Sir Roderick Murchison, that they are exclusively confined to this epoch, still holds good as far as all the typical forms of the order are concerned. The somewhat aberrant genus *Dictyonema* (which, along with some others, might fairly be placed in a distinct suborder) has been found by Hall in the Middle Old Red in America. This discovery would lead us to anticipate a similar revelation in Britain, whenever beds shall have been examined in this formation which present evidence of having offered the requisite conditions for the growth and preservation of these organisms. Further, the same genus *Dictyonema* occurs in the Tremadoc Slates, which are by some looked upon as the top of the Upper Cambrian series. Nevertheless it remains certain that the Graptolites as a family are characteristically Silurian; and further researches are not likely to alter this statement in any essential point. Not only is this the case, but the Graptolites, as regards their abundance as individuals, and the number of generic and specific types, are far more characteristic of the Lower- than of the Upper-Silurian period. And, finally, the inferior portions of the Lower Silurian rocks can claim a decided predominance in the number of genera when compared with the superior members of the same.

Contrary to what might have been expected, the various genera, and often the species also, of Graptolites are very constant in their range and distribution. They afford, therefore, very valuable and reliable data, whereby formations in different parts of the world may be correlated with one another or the exact position held by any group of beds in the stratified series may be more or less exactly ascertained.

In Britain Graptolites are known to range from the Tremadoc Slates up to the Upper Ludlow rocks, inclusive, the Lower Llandeilo, Upper Llandeilo, and Caradoc groups being those in which there is the maximum development of genera and species, usually accompanied in the two latter cases by an extraordinary abundance of individuals. On the whole, the lower part of the Lower Llandeilo (Skiddaw Slates), as stated by Salter, must be looked upon as the "metropolis" of the family, since it contains a larger number and a more varied series of generic types than is found in any other formation. The Upper Llandeilo and Caradoc groups, on the other hand, possess together a much greater number of species and of individuals than is the case with the Lower Llandeilos, though this is, perhaps, largely due to the more favourable nature of their sediments, the same disproportion not being recognized in America.

Looking merely to Britain, the Lower Silurian rocks are

characterized by the exclusive possession of the genera *Dictyonema*, *Dichograpsus*, *Tetragrapsus*, *Dendrograpsus*, *Phyllograpsus*, *Pleurograpsus*, *Helicograpsus*, *Cyrtograpsus*, *Callograpsus*, *Diplograpsus*, *Climacograpsus*, *Dicranograpsus*, *Didymograpsus*, and *Rastrites*. Of the remaining British genera, *Graptolites* and *Retiolites* are common to both the lower and upper divisions of the Silurian series. The same is really the case with *Ptilograpsus*, for, though not known to occur in Britain out of the Lower Ludlow rocks, it is a characteristic genus in the Quebec group of Canada. It may therefore be said that the Upper Silurian rocks of Britain are not in the exclusive possession of any genus of Graptolites.

The genus *Dictyonema*, Hall, occurs in the Tremadoc Slates (Uppermost Lingula Flags of Salter, Upper Cambrian of Belt), in the Lower Llandeilo, and in the Caradoc group. Though represented in America by various species in the Quebec group, it has not as yet been found in the corresponding strata in Britain, viz. the Skiddaw Slates (lowest Llandeilo). The species of the Tremadoc Slates is the familiar *D. sociale*, Salt.; and an undetermined form, possibly the same, is found in the Lower Llandeilo rocks of the Shelve district. The Upper Llandeilo rocks have not hitherto yielded any example of the genus; but a single example (apparently *D. gracile*, Hall) has been discovered by Prof. Harkness in the Bala Limestone of Girvan. The younger deposits of Britain have not been shown to contain any species of *Dictyonema*; but such have been found in the Upper Silurians of America, and even in the Middle Old Red Sandstone (Upper Helderberg and Hamilton groups); so that the genus cannot be looked upon as characteristic of any portion of the Silurian period.

The genera *Dichograpsus*, *Tetragrapsus*, and *Phyllograpsus* are exclusively confined to the Skiddaw and Quebec groups, both at home and abroad, being represented by several species in the Skiddaw Slates of Cumberland and Westmoreland. (See Quart. Journ. Geol. Soc. vol. xix. p. 137, and vol. xxiv. p. 125 *et seq.*). *Phyllograpsus*, represented by its two most typical species, viz. *P. angustifolius* and *P. typus*, appears to range throughout the entire group; but *Dichograpsus* and *Tetragrapsus*, with four species each, seem to be confined to the lower beds of the series. No member of these three genera has hitherto been found in the equivalent strata in Wales (Whitesand Bay).

The genus *Dendrograpsus*, Hall, is mostly characteristic of the base of the Lower Silurian series. One species, viz. *D. Hallianus*, Prout, has been dubiously determined from the Skiddaw Slates; and *D. furcatula*, Salt., from the Lower

Llandeilo rocks of Wales, would seem to be referable to the same species. Another form, viz. *D. flexuosus*, Hall, has been recognized by Mr. Baily in the Caradocs of Ireland.

The genus *Climacograpsus*, Hall (=*Diplograpsus* in part) has a vertical range from the Lowest Llandeilo up to the Lower Llandovery, having its maximum development in the Upper Llandeilo and Caradoc groups. It will thus be seen that *Climacograpsus* is strictly coordinate in its range with the limits of the Lower Silurian rocks, of which its members may therefore be considered characteristic fossils. The most typical and familiar species, *C. teretiusculus*, His., has the same range as the genus. It commences in the upper beds of the Skiddaw Slates, is of tolerably frequent occurrence in the Lower Llandeilo rocks of Wales, attains its maximum of abundance in the Upper Llandeilo and Caradoc groups, and is known in the Lower Llandovery by a single specimen only, which was discovered by Prof. Harkness. A second species, viz. *C. antennarius*, Hall, also occurs in the Skiddaw Slates; but it appears to have died out before the deposition of even the upper beds of this formation, and it is not known to occur in any of the higher groups. Of the remaining species, *C. bicornis*, Hall, occurs in the Lower Llandeilo rocks, but is much more frequently found in the Upper Llandeilos; whilst *C. tuberculatus*, Nich. (MS.), is confined to the last-named group.

The closely allied genus *Diplograpsus*, M'Coy, is, like the last, exclusively confined to, and essentially characteristic of, the Lower Silurian period. Its range, however, is not quite so wide, inasmuch as it is not yet known to transcend the limits of the Caradoc series, though it commences as early as the Skiddaw Slates. Of the British species, *D. pristiniformis*, Hall, and *D. mucronatus*, Hall, are the oldest, the former being confined to the Skiddaw group, whilst the latter passes up into the Upper Llandeilo, and in America occurs also in the Caradocs* (Utica Slate and Hudson-River group). *D. Whitfieldii*, Hall, *D. cometa*, Gein., *D. nodosus*, Harkn., *D. acuminatus*, Nich., and *D. Harknessii*, Nich., appear to be exclusively Upper-Llandeilo species in Britain, the first passing up into the Caradocs in America. *D. pristis*, His., *D. angustifolius*, Hall, *D. palmeus*, Barr. (including *D. folium*, His.), *D. tamariscus*, Nich., and *D. vesiculosus*, Nich., are all characteristic fossils both in the Upper Llandeilo rocks and in the Coniston Flags (Caradoc). *D. putillus*, Hall, originally described from the Utica Slate, and *D. confertus*, Nich., are the

* *D. mucronatus* appears also to occur in the Caradocs of Ireland.

only British species as yet known to be confined to the Coniston Flags.

The genus *Dicranograpsus*, Hall, comprising the single species *D. ramosus* (the old *Diplograpsus ramosus*), ranges through the Lower and Upper Llandeilos, and is said to have been found in the Coniston Flags (Caradoc). It is, however, most characteristically a fossil of the Upper Llandeilo rocks in Britain.

The genus *Didymograpsus* appears to have both its commencement and its maximum in the Skiddaw and Quebec groups, being represented in Britain by eight species from the Skiddaw Slates, viz. *D. nitidus*, Hall, *D. bifidus*, Hall, *D. V-fractus*, Salt., *D. affinis*, Nich. (MS.), *D. patulus*, Hall, *D. geminus*, His., *D. serratulus*, Hall, and *D. sextans*, Hall. Of these the first four are exclusively confined to this horizon in the stratified series; *D. geminus*, His., and *D. patulus*, Hall, are also very characteristic fossils in the Lower Llandeilo rocks; *D. sextans*, Hall, occurs plentifully in the Upper Llandeilos, and *D. serratulus* is found in the Utica Slate (Caradoc) of America. In the Upper Llandeilo rocks the genus *Didymograpsus* is highly characteristic, and is represented by *D. Murchisoni*, Beck, *D. flaccidus*, Hall, *D. divaricatus*, Hall, *D. sextans*, Hall, and *D. anceps*, Nich., of which *D. Murchisoni*, though curiously local in its occurrence, is perhaps one of the most characteristic. It is worthy of remark that no *Didymograpsus* has hitherto been found in the Caradoc group in England, not even in the Coniston Flags, though these abound in Graptolites and contain so many species common to the Utica Slates of America, in which the genus is represented by *D. sextans*, *D. serratulus*, *D. divaricatus*, and *D. flaccidus*. In Ireland, however, at least two species of *Didymograpsus* are said to occur in strata of Caradoc age (Baily).

The genus *Rastrites* of Barrande appears not to occur either in the Skiddaw Slates or in the Lower Llandeilo proper, but to be exclusively confined to the Upper Llandeilo and Caradoc groups. In the former of these, *R. peregrinus*, Barr., *R. Linnæi*, Barr., and *R. capillaris*, Carr., are characteristic fossils; and the two former of these are also found in the Coniston Flags.

The genus *Pleurograpsus*, Nich., is doubtfully represented in the Skiddaw Slates by a single species, *P. vagans*, Nich., the typical form (viz. *P. linearis*, Carr.) being confined to the Upper Llandeilo rocks.

Helicograpsus, Nich., comprising the single species *H. gracilis*, Hall (the *Graptolithus gracilis* of Hall), is found in the

Upper Llandeilo rocks of Scotland, and has been also made out in the Caradoc group in Ireland.

In these latter beds Mr. Baily has likewise determined the existence of the genus *Callograpsus*, Hall, by the single species *C. elegans*, Hall. This genus, which is otherwise confined to the Quebec group, is in most respects intermediate between *Dendrograpsus* and *Dictyonema*.

The genus *Cyrtograpsus*, Carr., appears to have a range similar to that of *Helicograpsus* (viz. Upper Llandeilo and Caradoc).

The remaining three genera of British Graptolites, namely, *Retiolites*, *Graptolites*, and *Ptilograpsus*, are common to both the upper and lower divisions of the Silurian rocks, though the last has not as yet been detected in Britain except in the Upper Silurians.

The genus *Graptolites*, Linn., doubtfully represented in the Lower Llandeilos by a single species, and largely represented in the Upper Llandeilos, attains its maximum in the Caradoc series (Coniston Flags). At this point most of the species of the genus appear to have died out, no more than four passing up into younger deposits. With the doubtful exception of *G. sagittarius*—a determination which may have been founded on a fragment of a compound species—no completely satisfactory instance is known to me of the occurrence of any member of the genus *Graptolites* either in the Skiddaw Slates or in the Lower Llandeilo proper. In the Upper Llandeilo rocks the genus is represented by *G. sagittarius*, Linn., *G. Sedgwickii*, Portl., *G. lobiferus*, M'Coy, *G. tenuis*, Portl., *G. Nilssoni*, Barr., *G. priodon*, Bronn, and *G. fimbriatus*, Nich. All these forms, however, pass upwards; so that the Upper Llandeilo rocks cannot be said to possess any species of this genus peculiar to themselves. In the Coniston Flags (Caradoc), besides all the species above mentioned, there occur also *G. turriculatus*, Barr., *G. Bohemicus*, Barr., *G. discretus*, Nich., and *G. colonus*, Barr., this last passing on, together with *G. priodon*, into the overlying Coniston Grits, which would seem to be likewise of Caradoc age. The four species which survive into the Upper Silurian period are *G. priodon*, *G. colonus*, *G. Flemingii*, Salt., and an undetermined form from the Ludlow rocks. Of these, *G. Flemingii* is peculiar to the Wenlock formation; but the first two are found in both the Wenlock and Ludlow rocks. Of all the species of the genus, *G. priodon* has the most extensive vertical range, passing from the Upper Llandeilo up to the Upper Ludlow formation.

The genus *Retiolites*, Barr., has hitherto not been found in

either the Skiddaw Slates or the Lower Llandeilo proper, though its discovery in the former of these may fairly be anticipated. In the Upper Llandeilo rocks of the south of Scotland a single species has been found, apparently *R. venosus*, Hall; and a second species, *R. perlatus*, Nich., occurs in the Coniston Flags; but this may possibly turn out to be a large variety of the former. The third and longest-lived British species is *R. Geinitzianus*, Barrande, which occurs plentifully in the Coniston Flags (Caradoc), and has also been found in the Ludlow rocks of the Pentland Hills, near Edinburgh.

The genus *Ptilograpsus*, Hall, is known as occurring in Britain by a single species only, *P. anglicus*, Nich., which is found in the Lower Ludlow rocks. The two remaining species of *Ptilograpsus* occur in the Quebec group in Canada; but no member of the genus has as yet been discovered in any of the intervening formations.

Summary.

Of the above-mentioned British genera of Graptolites, in number seventeen, it will be seen that fourteen are, as far as is yet known, entirely and exclusively confined to the Lower Silurian series, two are common to both the Lower and Upper divisions, and *Ptilograpsus* alone is confined to the Upper Silurian rocks. As, however, this last-named genus is found in the Quebec group, the Upper-Silurian period cannot be said to possess a single characteristic genus of the family, and it possesses but two peculiar species.

In the Tremadoc Slates (Upper Cambrian?) no other genus is known to occur than *Dictyonema*, and this is represented by a single species. The Skiddaw Slates (Lowest Llandeilo) are specially characterized by the exclusive possession of the genera *Dichograpsus*, *Tetragrapsus*, and *Phyllograpsus*, and of the species *Diplograpsus antennarius*, *D. pristiniformis*, *Didymograpsus nitidus*, *D. V-fractus*, and *D. affinis*. The Skiddaw Slates contain altogether eight genera and twenty-four species, of which three genera and thirteen species belong also to the Quebec group. Two species occur also as characteristic fossils in the Lower Llandeilo rocks of Wales and Sweden. Five species are peculiar to the Slates, and the remaining four occur either in the Upper Llandeilo or in the Caradoc groups. Out of nineteen species, not peculiar to the Skiddaw Slates, thirteen, or more than two-thirds, are common to the Quebec group of Canada, a close relationship between the two formations being thus demonstrated.

The Lower Llandeilo rocks proper are specially charac-

terized by the possession, though not exclusive, of the species *Didymograpsus geminus*, *D. patulus* (=*D. hirundo*, Salt.), and *Dendrograpsus Hallianus*, of which the two former occur also in the Alum Slates of Aher, in Sweden.

The Upper Llandeilo rocks of Britain contain thirty-four species, belonging to ten genera. Of the whole number of species, sixteen, or nearly one-half, are common to the Coniston Flags, eleven are peculiar to this horizon, and thirteen are found in the Utica Slate and Hudson-River group in America. From this it will be seen that, taken as a whole, and as far as the Graptolites alone are concerned, it is impossible to make any separation between the Upper-Llandeilo and Caradoc periods. The two periods, viewed together, are characterized by the great abundance of members of the genera *Diplograpsus*, *Climacograpsus*, *Graptolites*, *Rastrites*, and *Dicranograpsus*, of which the two latter do not occur in either younger or older formations. Amongst the species most highly characteristic of the two groups may be mentioned *Diplograpsus pristis*, *D. angustifolius*, *D. palmeus*, *D. tamariscus*, *Graptolites Sedgwickii*, *G. sagittarius*, *G. lobiferus*, *G. Nilssoni*, *Rastrites peregrinus*, *R. Linnæi*, and *Dicranograpsus ramosus*.

The Caradoc rocks, as a rule, do not yield any Graptolites; but striking exceptions are found to this statement in the Coniston Flags and in some of the Caradoc beds in Ireland. The Coniston Flags contain twenty-four species, belonging to six genera. Of these, six species occur in the Utica Slate and Hudson-River group of America, a decided relationship between the two formations being thus established. A still more decided connexion is found to exist between the Graptolites of the Coniston Flags and those of Barrande's "étage E," twelve of the species which occur in the former (constituting one-half of their entire number) being found in the latter also. Amongst the Graptolites which are not found in Britain elsewhere than in the Coniston Flags are *Graptolites turriculatus*, *G. Bohemicus*, *G. discretus*, *Diplograpsus putillus*, and *D. confertus*.

In the Caradoc beds in Ireland there are found, amongst other species, *Diplograpsus pristis*, *D. mucronatus*, *Didymograpsus sextans*, *Helicograpsus gracilis*, *Graptolites Nilssoni*, *G. Sedgwickii*, *G. priodon*, *Dendrograpsus flexuosus*, and *Callograpsus elegans*. Most of these are common to the Upper Llandeilo rocks and Coniston Flags; the first four occur in the Utica Slate and Hudson-River group of America; and the last two are characteristic species in the Quebec group of Canada.

In the Lower Llandovery rocks one Graptolite only has

been found, viz. *Climacograpsus teretiusculus*, a highly characteristic Lower-Silurian fossil.

In the Wenlock rocks there is but one peculiar species, namely *Graptolites Flemingii*; *G. priodon* and *G. colonus* being common but not confined to the group. The sole peculiar species, *G. Flemingii*, is only known to occur in one locality (Balmae in Kircudbright), in beds supposed to be of the age of the Wenlock Shale. *Retiolites Geinitzianus* has been looked upon as a characteristic Wenlock form; but it occurs abundantly, with Lower-Silurian species, in the Coniston Flags, and it appears to have lived on into the Ludlow period.

In the Lower Ludlow rocks the beautiful *Ptilograpsus anglicus* has hitherto been exclusively found, whilst in both the Lower and Upper Ludlows *G. priodon* and *G. colonus* are of common occurrence.

Subjoined are tables showing the distribution in time of the genera and species of Graptolitidæ which have been discovered in Britain.

Table showing the Vertical Distribution of the British Genera of the Family of the Graptolitidæ.

Genera.	Tremadoc Slates.	Skiddaw Slates (Lowest Llandeilo).	Lower Llandeilo.	Upper Llandeilo.	Caradoc.	Lower Llandovery.	Upper Llandovery.	Wenlock.	Lower Ludlow.	Upper Ludlow.
Dictyonema	*	..	*	..	*					
Dichograpsus	..	*								
Tetragrapsus	..	*								
Phyllograpsus	..	*								
Dendrograpsus	..	*	*	..	*					
Climacograpsus	..	*	*	*	*	*				
Diplograpsus	..	*	*	*	*					
Didymograpsus	..	*	*	*	*					
Pleurograpsus	..	?	..	*						
Graptolites	..	?	?	*	*	*	*	*	*	*
Rastrites	..	..	..	*	*					
Helicograpsus	..	..	..	*	*					
Cyrtograpsus	..	..	..	*						
Retiolites	..	..	..	*	*	..	..	*	*	
Dicranograpsus	..	..	*	*	?					
Callograpsus	..	..	..	..	*					
Ptilograpsus	..	..	..	..	..	..	..	..	*	

Table showing the Geological Distribution of the Species of Graptolitidæ in Britain.

Species.	Tremadoc Slates.	Skiddaw Slates (Lowest Llandeilo).	Lower Llandeilo.	Upper Llandeilo.	Caradoc.	Lower Llandovery.	Upper Llandovery.	Wenlock.	Lower Ludlow.	Upper Ludlow.
Dictyonema sociale, *Salt.*	*									
gracile, *Hall* (?)	..	..	..	..	*					
Dichograpsus Logani, *Hall*	..	*								
multiplex, *Nich.*	..	*								
octobrachiatus, *Hall*	..	*								
reticulatus, *Nich.*	..	*								
Tetragrapsus bryonoides, *Hall*	..	*								
crucifer, *Hall*	..	*								
Headi, *Hall*	..	*								
quadribrachiatus, *Hall*	..	*								
Phyllograpsus angustifolius, *Hall*	..	*								
typus, *Hall*	..	*								
Dendrograpsus Hallianus, *Prout*	..	*	*							
flexuosus, *Hall*	..	..	..	..	*					
Climacograpsus antennarius, *Hall*	..	*								
bicornis, *Hall*	..	..	*	*						
teretiusculus, *His.*	..	*	*	*	*	*				
tuberculatus, *Nich.*	..	..	..	*						
Diplograpsus acuminatus, *Nich.*	..	..	..	*						
angustifolius, *Hall*	..	..	..	*	*					
cometa, *Gein.*	..	..	..	*						
confertus, *Nich.*	..	..	..	..	*					
Harknessii, *Nich.*	..	..	..	*						
mucronatus, *Hall*	..	*	*	*	*					
nodosus, *Harkn.*	..	..	..	*						
palmeus, *Barrande* (=D. folium, *His.*)	..	..	..	*	*					
pristiniformis, *Hall*	..	*								
pristis, *His.*	..	?	..	*	*					
putillus, *Hall*	..	..	..	..	*					
tamariscus, *Nich.*	..	..	..	*	*					
vesiculosus, *Nich.*	..	..	..	*	*					
Whitfieldii, *Hall*	..	..	..	*						
Didymograpsus affinis, *Nich.*	..	*								
anceps, *Nich.*	..	..	..	*						
bifidus, *Hall*	..	*								
divaricatus, *Hall*	..	..	..	*						
flaccidus, *Hall*	..	..	..	*						
geminus, *His.*	..	*	*							
Murchisoni, *Beck*	..	..	..	*						
nitidus, *Hall*	..	*								
patulus, *Hall*	..	*	*							
serratulus, *Hall*	..	*								
sextans, *Hall*	..	?	..	*	*					
V-fractus, *Salt.*	..	*								

Table (*continued*).

Species.	Tremadoc Slates.	Skiddaw Slates (Lowest Llandeilo).	Lower Llandeilo.	Upper Llandeilo.	Caradoc.	Lower Llandovery.	Upper Llandovery.	Wenlock.	Lower Ludlow.	Upper Ludlow.
Pleurograpsus linearis, *Carr.*	..	..	..	*						
vagans, *Nich.*	..	*								
Graptolites Bohemicus, *Barr.*	..	..	..	..	*					
colonus, *Barr.*	..	..	..	..	*	..	..	*	*	*
discretus, *Nich.*	..	..	..	..	*					
fimbriatus, *Nich.*	..	..	..	*	*					
Flemingii, *Salt.*	..	..	..	..	..	..	..	*		
lobiferus, *M'Coy*	..	..	..	*	*					
Nilssonii, *Barr.*	..	..	..	*	*					
priodon, *Bronn*	..	..	..	*	*	*	*	*	*	*
sagittarius, *Linn.*	..	..	?	*	*					
Sedgwickii, *Portl.*	..	..	..	*	*					
tenuis, *Portl.*	..	..	..	*	*					
turriculatus, *Barr.*	..	..	..	..	*					
Rastrites capillaris, *Carr.*	..	..	..	*						
Linnæi, *Barr.*	..	..	..	*	*					
peregrinus, *Barr.*	..	..	..	*	*					
Helicograpsus gracilis, *Hall*	..	..	..	*	*					
Cyrtograpsus Murchisoni, *Carr.*	..	..	..	*						
Retiolites Geinitzianus, *Barr.*	..	..	..	..	*	..	..	*	..	*
perlatus, *Nich.*	..	..	..	..	*					
venosus, *Hall*	..	..	..	*						
Dicranograpsus ramosus, *Hall*	..	..	*	*	*					
Callograpsus elegans, *Hall*	..	..	..	..	*					
Ptilograpsus anglicus, *Nich.*	..	..	..	..	..	..	..	..	*	

XLII.—*Remarks upon Mr. J. Gwyn Jeffreys's last Dredging Report.* By R. M'Andrew, F.R.S.

My friend Mr. Jeffreys, in the Dredging Report read by him at the Norwich Meeting of the British Association, and published in the Number of the 'Annals of Natural History' for last month, gives a summary of observations previously recorded by him; and as some of these are not in accordance with the result of my dredging experience, I feel called upon to state the grounds upon which I am compelled to differ from one who is generally so trustworthy an authority, and to make a few remarks bearing upon the questions at issue. Mr. Jeffreys states:—

"1. The bathymetrical zones have been too much divided

by Risso and subsequent authors. There are two principal zones, the littoral and the submarine; the nature of habitat and supply of food influence the residence and migration of animals, not the depth of water. *Psammobia costulata* and *Buccinum undatum* are instances in support of this proposition."

Now a natural inference from this would be that, excepting those which are littoral, the species inhabit all depths indifferently, which I know it could never have been Mr. Jeffreys's intention to imply. Admitting that "the nature of the habitat and supply of food influence the residence of animals," it is evident that these must vary to meet the requirements of different species, also that *depth* is not only itself an important element in the nature of a habitat, but must have considerable influence on the food of Mollusca. For instance, the *Laminaria* does not grow below 15 or 20 fathoms at the most; several species of Mollusca are entirely dependent upon *Laminaria* for food, and consequently are strictly confined to its zone. In most cases the conditions cannot be so easily defined; but it is nevertheless a fact that most, if not all, the species of Mollusca have their maximum of development at a particular depth—and that while some enjoy a considerable bathymetrical range, others are confined within comparatively narrow limits—and that, in consequence of the great interest attached to vertical distribution, it has been found convenient to institute zones of depth as well as geographical provinces.

According to Forbes, there exist in the eastern Mediterranean eight well-marked regions of depth, each characterized by its peculiar fauna. As this conclusion was arrived at after some eighteen months of research by no ordinary observer, I consider that it is entitled to respect until the data upon which it is founded, set forth in the Report on the Ægean Invertebrata, shall have been proved to be erroneous. It does not follow that observations made in the Ægean Sea are of universal application, or that different conditions in the ocean or other seas may not require a modification in the number or extent of the zones. Where the action of the tide is considerable, there are, in fact, an upper and a lower littoral zone—some species of Mollusca as well as of marine plants being found even beyond the reach of ordinary tides, while others are not to be met with much above the lowest water-mark. It is to be noted that the same species often frequent different depths in different seas; and in these cases it is generally where the climate and other conditions are most favourable to their existence and multiplication that they inhabit the shallowest water. Several of the rare Shetland species, which might

there be searched for in vain in less than about 80 fathoms, are to be met with in much shallower water and greater frequency on the coasts of northern Norway.

Mr. Jeffreys's second proposition, that individuals and varieties are generally of smaller size when found in deep water, is confirmed by my own observation; and I proceed to

3. "The size of North-European specimens is usually greater than that of South-European specimens of the same species,"—from which I must record my dissent, more especially if it is meant to be implied that size diminishes in proportion to southern latitude.

The examples he names in support of his hypothesis do not bear it out, but might generally be quoted to prove (though there are many exceptions) what I conceive to be the true theory, viz. that species attain their largest dimensions under those latitudes and conditions, though not in the particular localities, most favourable to their numerical development; and it is quite consistent with this proposition that certain species which find in high northern latitudes the circumstances most favourable to their existence and increase (*Saxicava arctica*, *Arca raridentata*, and *Chiton Hanleyi* may be taken as instances) should attain smaller growth in more southern regions.

Pecten septemradiatus I have dredged on the Scandinavian coast as far north as Finmark, without obtaining in its more northern habitat a specimen so large as those of Loch Fyne, or even larger than those of the Sicilian species (*P. clavatus* of Poli) which Mr. Jeffreys assumes to be identical with it. *Pecten opercularis*, *Astarte sulcata*, *Artemis exoleta*, *A. lincta*, and *Natica Alderi* all appear to attain their greatest dimensions in the British seas; but they are all distributed from the Mediterranean or coasts of Spain to those of Nordland or Finmark, and I have found them all as large in their more southern as in their more northern habitat. My specimens of *Astarte sulcata* from Gibraltar and from Finmark, the extremes of its range, are of equal size, and, in fact, not distinguishable one from the other. *Lima hians* I have found largest at Oban; specimens from Nordland are similar to those from Loch Fyne. *Mytilus adriaticus* is, as far as my observation goes, smaller in more southern localities than in Britain; and I am not aware of its having been met with further north; but in my Dredging Report of 1856 I have given Britain as the locality of its principal development. The same observations will apply to *Defrancia teres* and *Bulla utriculus* as to *Mytilus adriaticus*, unless the former should prove to be identical with *Pleurotoma boreale* of Lovén.

Of the distribution of *Isocordia cor* our information is imperfect. The Dublin-Bay specimens are, I believe, the largest. I have dredged it in at least two localities in the Hebrides, though only dead in an adult state, my largest examples much below the ordinary dimensions of the species.

Tellina balaustina is of extreme rarity in the Atlantic, where next to nothing is known of its distribution. Except on our northern coasts, the only Atlantic specimen of which information has reached me is a single valve obtained by myself, in company with the late Dr. S. P. Woodward, off Cape Finisterre of Spain. In the Mediterranean the size I have found to vary, not from north to south, but from east to west, being smallest in the Ægean and largest at Gibraltar; so that this species does not throw any light upon the question.

Tectura virginea is about as large in the Bay of Vigo as in the British seas, much larger than I have procured it from more northern latitudes on the Scandinavian coast.

Of *Defrancia purpurea* my finest and largest specimens were obtained at Vigo.

The foregoing examples (not selected by me, but by Mr. Jeffreys) render it, I conceive, needless for me to bring forward any instances in support of my views. I may, however, name a few of the commonest and best-known Mollusca of our shores, as *Purpura lapillus*, which I have found largest in the south of England, *Mytilus edulis* at Algiers, *Buccinum undatum* in Shetland (frequent in the neighbourhood of the North Cape, where it is much smaller), *Fusus antiquus* in Liverpool Bay, &c.

I should not omit mention of two striking exceptions to what I conceive to be the general rule—viz. *Haliotis tuberculata* and *Chiton cajetanus*, both of which attain their largest dimensions in their most northern habitat, the Channel Islands and south coast of Brittany respectively. This I do not pretend to account for. They do not progressively augment in proportion to their northern latitude, as I have obtained both species on the north coast of Spain, where they are no larger than in the Mediterranean. Other southern species which find their northern limit on our coasts (e. g. *Venus verrucosa*, *Cytherea chione*, *Cardiu maculeatum*, and *C. tuberculatum*) are larger in the Mediterranean. I could cite a few exceptional instances of specimens being larger in their southern distribution; but, to show that there are other conditions besides latitude which affect growth, I will mention that the individuals of *Chiton fascicularis* are uniformly larger at Mogador than I have found them elsewhere, while at no great distance, at Lancerote, they are much smaller than in any locality that I

am acquainted with. In the former case they were littoral, in the latter on a red *Fucus* obtained from a depth of from 10 to 20 fathoms.

4. "The colour of specimens from the greatest depths is not less vivid than from shallow water," &c. This statement would imply either that no rays of light are intercepted or deflected in their passage through water (in which case we ought to be able to see objects as well through this medium as through air)—or that light has no effect upon colour, which I may venture to say is not the case. I have no reason to suppose that colour is affected by depth, except in relation to the supply of light, or that the effect of light is appreciable except where the colour is superficial. The colour of our blood may be independent of the action of light, though not so that of our complexions. It should be observed that in some of the examples mentioned by Mr. Jeffreys the colouring-matter permeates the substance of the shell; and with respect to *Venus ovata* I must add that my experience is at variance with his statement, which I therefore presume must be founded upon some exceptional case. There are in the national collection specimens, not selected, of *Venus ovata* and *V. striatula*, procured by me from a depth of 80 fathoms and upwards, which will be found to be of a chalky consistency and almost destitute of colour.

The effect of light in heightening the superficial colour, particularly the brighter hues of shells, is evident on comparing together specimens of the same species from different latitudes. *Venus ovata*, *V. verrucosa*, *V. casina*, all the British species of *Tapes*, *Circe minima*, and many others have much more colour in the latitude of the Mediterranean than in our seas, which is naturally attributable to exposure to a more intense light.

It is a remark of Forbes, which my own observation has confirmed, that the species of Mollusca peculiar to great depths are generally void of colour.

Of the remaining propositions I will only remark upon

7. "Exotic and oceanic shells are carried northward by westerly winds, and not directly by the Gulf-stream, which does not reach our coasts," that I do not see how the distribution of Mollusca inhabiting the bottom of the sea can be affected by winds, from the direct influence of which they are so effectually removed. With respect to animals frequenting the surface of the ocean, such as *Ianthina* and *Velella*, which occasionally appear on our coasts in considerable numbers after a prevalence of westerly or south-westerly winds, they are temporary visitors, and have not succeeded in establishing themselves permanently in our seas.

The currents by which most parts of the Atlantic are more or less affected, and of which the Gulf-stream is the most important, generally prevail from the west. Along the coast of Norway the action is decidedly from south to north, and has the effect of keeping the entrance of the most northern ports, such as Hammerfest, free from ice at all seasons. To the south of the Bay of Biscay, more particularly south of Gibraltar, the current sets southward, past the Canary Islands; but I cannot say that I have been able to detect any effect from these currents upon the distribution of Mollusca—a subject to which I have paid some attention.

It is a remarkable fact that the shells of the Açores are of European and West-African species, and not American, as would have been the case had they been carried there by the prevailing currents; and, what is still more remarkable, the *Littorina* most abundant in these islands (*L. striata*) is not a European species, but common to the Madeira, Canary, and Cape Verde Islands, and to the west coast of Africa—a circumstance deserving the attention of geologists, as pointing to a former distribution of land.

Isleworth House, Oct. 16, 1868.

XLIII.—*On* Ophiocrinus, *a new Genus of* Comatulidæ.

By Dr. C. Semper, of Würzburg*.

Among the numerous Comatulidæ found by me at Bohol, there is one species possessing only five, wholly undivided arms. At first I held it to be a young specimen of some real *Comatula*; but, not corresponding exactly to any of the Philippine species, I consider myself justified in describing it as a separate species. In this case the fact of the arms being undivided gives it a claim to a separate genus.

Ophiocrinus, n. gen.

Five wholly undivided arms; they spring direct from the central knob, which below bears the cirrhi: other ossicula of the calyx are entirely wanting throughout. Disk ——?

Ophiocrinus indivisus, n. sp.

Sixteen cirrhi range in a single row around the small flat knob. Joints of the cirrhi 18–20, very knotty, especially at the basis; the knots correspond to the articulations: the first two joints are short, as high as they are broad; the third to sixth are

* Translated by Frau Anna Semper.

the longest, twice as long as they are wide. The last joints slightly compressed, smooth; the last has a strong tooth besides the final hook. The first joint of the arms, arising direct from the knob of the calix, bears a pinnula immediately and has a syzygium; the second is without a pinnula; the third bears one; and the fourth has a pinnula, and also a syzygium. Then the pinnulæ succeed each other, alternating regularly, and always one syzygium between 3–5 joints. The joints of the arms are nearly twice as long as they are high, and, especially in the centre, are strongly wedged sideways. The first two pinnulæ are small, the third and fourth the longest; then follow shorter ones, which, towards the end of the arms, gradually become longer and thinner, whilst the first issue with rather a broad basis. Length of the arms 80 millims., of the cirrhi 9 millims., of the longest pinnulæ 8 millims; the diameter of the central knob is 2 millims.

Unfortunately the disk is missing in the single specimen. The pinnulæ are speckled over with light and dark yellowish brown; the back of the arms is marked by two winding lines.

Pandanon, near Bohol (Philippines), at a depth of 30 fathoms.

XLIV.—*On the Species of* Cæcidæ, Corbulidæ, Volutidæ, Cancellariidæ, *and* Patellidæ *found in Japan.* By Arthur Adams, F.L.S. &c.

Pursuing my investigations into the molluscan fauna of the Japanese Islands, I have in this communication to identify, enumerate, and systematically arrange the species of some families of which our knowledge in respect to geographical distribution was formerly somewhat limited. With regard to those curious but minute creatures, the *Cæca*, it appears strange that I should have met with no new species. As to such a littoral family as Patellidæ, it is not singular that all the species should have been previously known, as casual observers and sailors are pretty sure to collect them. These shore-inhabiting species are subject to very great variation; and the chief difficulty in dealing with them consists in disposing of the varieties into groups which are natural, so as to reduce the number of the so-called species. All the localities are given solely on my own authority. Numerous other families still remain to be worked out before we can arrive at even an approximate knowledge of the Mollusca of Japan. The specimens forming the material from which this enumeration has

been derived were all collected by me during my explorations among the islands of the Japanese archipelago.

Fam. Cæcidæ.

In order to ascertain what small species of shells were found in the seas of Japan, I was accustomed to reserve a portion of the bottom which was brought up in the dredge, and have it carefully washed and dried. In leisure moments I looked over the mud and sand so prepared, and discovered many curious and beautiful forms, most of them never before viewed by human eye. Among them were numerous specimens of *Cæca*, which I have submitted to the scrutiny of my friend Dr. P. P. Carpenter, who has made the knowledge of this little group especially his own. His results I will now give in his own words. Akasi, from which place I obtained so many, is situated in the Seto-Uchi or Inland Sea.

1. *Cæcum gracile.*

"Mr. A. Adams obtained a large number of specimens at Gotto and Tanabe. Unfortunately all were dead, and mostly worn; but the characters of the species are plain. The shape and sculpture are almost exactly like *C. elegantissimum* on a larger scale; ribs generally 18–20, sharp and distinct, with wide curved interspaces. The plug is almost flat, and (the specimens being weathered) the apex is not to be traced. By this character and the scarcely slanting mouth it is easily known from the other Japanese species. Dr. Stimpson's specimen had an unusual number of ribs, and this sharpness was worn off. No opercula were found."

2. *Cæcum vitreum.*

"On a close microscopic comparison side by side with the Teneriffe specimens, I am unable to detect any constant difference, either in texture, shape, size, or form of plug. A large number of specimens, in fine condition, were obtained at Simoda, Akasi, O-Sima, and Tanabe. A variety has the plug flatter; another variety much raised."

3. *Cæcum dextroversum.*

"Several fresh specimens of this species were found at Akasi and O-Sima with the plug as variable as in the Mazatlan shells."

4. *Cæcum Clarkii.*

"Several specimens of this Teneriffe form were also found

at Akasi, and a few which are intermediate between this and *C. vitreum*, and may be the latter with the point rubbed off."

5. *Cæcum? mamillatum.*

"One large broken specimen from Akasi cannot be distinguished from the Crag fossil. The operculum has been forced inwards by detrital matter till it occupies the place of the plug which has perished."

1. *Brochina glabriformis.*

"A series of dead but nearly perfect specimens agree exactly with the Mazatlan shells. A few are almost identical with the British shells in plug, but are a shade larger. It is quite likely that the Pacific and Atlantic shells had a common origin."

2. *Brochina* (? var.) *glabella.*

"*B.* testa '*B. glabræ*' simillima, sed majore, septo parum convexo, subplanato, apice inconspicuo.

"Long. ·085, lat. ·02.

"*Hab.* Akasi and Tanabe, Japan. (A. Adams.)

"This may be only another variety of *B. glabra* on the contrary side. The specimens were few, of the size of *B. glabriformis*, and with the nearly flat plug of *C. gracile*."

Fam. **Corbulidæ.**

Genus Corbula, Brug.

1. *Corbula erythrodon*, Lam. Hist. Nat. d. An. s. Vert. vol. vi. p. 138.

Hab. Tatiyama, Yokohama.

2. *Corbula cuneata*, Hds. Moll. Voy. Sulph. pl. 20. f. 6.

Hab. Rifunsiri, Mososeki, Kuro-Sima.

3. *Corbula pallida*, Hds., Rve. Conch. Icon. pl. 2. f. 11.

Hab. Mososeki, 7 fathoms.

4. *Corbula venusta*, Gld. Otia Conch. p. 164; Schr. Moll. Amur-Lande, pl. 25. f. 1–4.

Hab. Gotto Islands, 48 fathoms; Hakodadi Bay, 5 fathoms.

5. *Corbula bifrons*, A. Ad. Ann. & Mag. Nat. Hist. 1860.

Hab. Seto-Uchi; Gotto; Mino-Sima, 63 fathoms.

Genus Azara, D'Orb.

1. *Azara amurensis*, Schrenck (*Corbula*), Moll. Amur-Lande, pl. 25. f. 5–8.

? *C. amplexa*, A. Ad., from estuary of Peiho River.

Hab. Castries Bay.

Genus Cryptomya, Conrad.

1. *Cryptomya elliptica*, A. Ad. (*Sphenia*) Proc. Zool. Soc. 1850, p. 88.

C. truncata, Gld., Otia Conch. p. 163.

Hab. Mososeki, 7 fathoms.

2. *Cryptomya mindorensis*, Ad. & Rve. (*Mya*), Moll. Voy. Sam. pl. 23. fig. 13.

Hab. Akasi, 14 fathoms.

3. *Cryptomya decurtata*, A. Ad. (*Sphenia*), Proc. Zool. Soc. 1850, p. 88.

Hab. Kuro-Sima.

Genus Eucharis, Récl.

1. *Eucharis Gouldi*, A. Ad. Ann. & Mag. N. H. 1864.

Hab. Seto-Uchi, Mososeki.

2. *Eucharis Stimpsoni*, A. Ad. Ann. & Mag. N. H. 1864.

Hab. Mososeki, 7 fathoms; Akasi.

3. *Eucharis Recluzi*, A. Ad. Ann. & Mag. N. H. 1864.

Hab. Yohuko.

Genus Neæra, Gray.

1. *Neæra elegans*, Hds. Proc. Zool. Soc. 1843, p. 76.

N. moluccana, Ad. & Rve. Moll. Voy. Sam.

Hab. Mino-Sima, 63 fathoms.

2. *Neæra nobilis*, A. Ad. Ann. & Mag. N. H. 1864.

Hab. Mino-Sima; Quelpart, 52 fathoms.

3. *Neæra Hindsiana*, A. Ad. Ann. & Mag. N. H. 1864.

Hab. Gotto, 48 fathoms.

4. *Neæra nasuta*, A. Ad. Ann. & Mag. N. H. 1864.

Hab. Satanomoseki, 55 fathoms.

5. *Neœra* (*Rhinomya*) *philippinensis*, Hds. Proc. Zool. Soc. 1843.
Hab. Uraga, Kino-O-Sima.

6. *Neœra* (*Rhinomya*) *rugata*, A. Ad. Ann. & Mag. N. H. 1864.
Hab. Tabu-Sima, 25 fathoms.

7. *Neœra* (*Cardiomya*) *Gouldiana*, Hds. Proc. Zool. Soc. 1843.
Hab. Uraga, Gotto Islands, Tsus-Sima.

Fam. **Volutidæ.**

Subfam. *Cymbiinæ.*

Genus Melo, Brod.

Melo Broderipii, Gray, Griff. An. Kingd. 1833.

M. regius, Brod.
Hab. Japan, teste Humphrey.

Subfam. *Volutinæ.*

Genus Fulgoraria, Schum.

Fulgoraria fulgura, Mart. iii. f. 841, 942.

V. rupestris, Gmel.
F. chinensis, Schum.
V. fulminata, Lam.
Harpula fulminata, Sw.
Hab. Mino-Sima, 63 fathoms.

Genus Scaphella, Swains.

Scaphella (*Alcithoë*) *megaspira*, Sow. Thes. Conch. 298, pl. 48. f. 31, 32.

V. lyriformis, Kien. (not Swains.).
Hab. Hakodadi Bay.

Genus Lyria, Gray.

1. *Lyria nucleus*, Lam. Hist. Nat. d. An. s. Vert.
Hab. Kino-O-Sima.

2. *Lyria cassidula*, Rve. (*Voluta*) Conch. Icon. sp. 60.
Hab. Tsusaki, 37 fathoms; Satanomosaki, 55 fathoms.

Genus Volutomitra, Gray.

Volutomitra pusilla, Schrenck (*Voluta*), Moll. Amur-Lande, pl. 17. f. 13–15.
Hab. Hakodadi (Lindholm).

Fam. **Cancellariidæ.**

Genus Cancellaria, Lam.

1. *Cancellaria Spengleriana*, Desh.

Reeve, Conch. Icon. Canc. sp. 11; Sow. Thes. f. 29.

Hab. Simidsu, Akasi, Mososeki.

2. *Cancellaria nodulifera.*

Sow. Thes. Conch. Canc. f. 57; Rve. Conch. Icon. sp. 6.

Hab. Kino-O-Sima, Simidsu.

3. *Cancellaria semipellucida*, Ad. & Rve.

Moll. Voy. Sam. pl. 10. f. 3, 3 *a*.

Hab. Mino-Sima, 63 fathoms.

Genus Trigonostoma, Blainv.

1. *Trigonostoma hæmastoma*, Sow.

Sow. Thes. Conch. Canc. f. 53–55; Rve. sp. 30.

Hab. Simidsu.

2. *Trigonostoma scalarina*, Chemn.

Sow. Thes. Conch. Canc. f. 87, 88; Rve. sp. 25.

Hab. Tsusaki, Mososeki.

Genus Merica, H. & A. Ad.

1. *Merica elegans*, Sow.

Sow. Thes. Conch. Canc. f. 36, 104; Rve. sp. 12.

Hab. Seto-Uchi, Tomo.

2. *Merica macrospira*, Ad. & Rve.

Zool. Voy. Sam. Moll. pl. 10. f. 2.

Hab. Mino-Sima.

3. *Merica Fischeri*, A. Ad.

Ann. & Mag. Nat. Hist. 1860.

Hab. Mino-Sima.

Genus Admete, Möll.

1. *Admete viridula*, O. Fabr.

Admete crispa, Möll. Ind. Moll. Scand.
Cancellaria viridula, Sow. Thes. f. 102.
C. Couthouyi, Jay.
C. buccinoides, Couth. (not Sow.).
C. costellifera, Hanc.

Hab. Aniwa Bay, 17 fathoms; Castle Point, Manchuria, 37 fathoms.

2. *Admete arctica*, Midd.

Cancellaria arctica, Midd.
Admete borealis, A. Ad.

Hab. Aniwa Bay, 17 fathoms.

Fam. **Patellidæ.**

Genus Patella, Linn.

1. *Patella testudinaria*, Linn. Syst. Nat. ed. 12.

P. testudinata, Martyn.
P. illuminata, Gld.

Hab. Nagasaki, Tsus-Sima, Sado, Simoda.

2. *Patella rustica*, Linn. Syst. Nat. ed. 12.

P. indica, Gmel.
P. piperita, Gld.
P. luzonica, Rve.

Hab. Tsus-Sima, Simoda, Tago, Awa-Sima.

3. *Patella saccharina*, Linn. Syst. Nat. ed. 12. p. 1258.

P. stellaris, Quoy & Gaim.
P. lanx, Rve.

Hab. Kino-O-Sima, Sado, Oki Islands.

4. *Patella elegans*, Phil.

P. nigrolineata, Rve.
P. grano-striata, Rve.
P. æruginosa, Midd.

Hab. Tsus-Sima.

5. *Patella tramoserica*, Chemn. Conch. Cab.

P.? *pentagona*, Born.
P. paumatensis, Gld.
P. cretacea, Rve.

Hab. Tsus-Sima.

6. *Patella argentata*, Gray, Zool. Beechey's Voy. Moll. pl. 39. f. 7.

P. amusitata, Rve.
P. toreuma, Rve.
P. affinis, Rve.
P. articulata, Rve.
?*P. grata*, Gld.

Hab. Hakodadi, Tatiyama, Simoda.

XLV.—*Notulæ Lichenologicæ.* No. XXIV.

By the Rev. W. A. Leighton, B.A., F.L.S.

*On the Gonimic Evolution of the Collemacei**.

By Dr. W. Nylander.

The nature of the Nostocs has been frequently investigated; and an hypothesis has prevailed that a Nostoc is a Collema in a young state, or that a Nostoc, on attaining a certain age, passes into a Collema. The actual transition, however, has hitherto escaped observation.

The real state of the case may be best demonstrated by attention to normal physiological conditions, rather than by observations founded on textures disrupted and torn asunder anatomically.

In the genus *Collema* the thallus possesses no distinct cortical layer. An isidium, when present on the upper surface (where alone it occurs), is granulose or furfuraceous, black, aggregate, and more frequently marginal. These granules, which are manifestly the propagula of the lichen which extrudes them, show very clearly under the microscope the entire history of the evolution of a thallus, from its first origin from a cellule containing a single gonimium to a minute true Nostoc (at least there is no apparent difference), and ultimately to the perfect texture of a Collema. We can thus see the mode in which these granules increase in magnitude. They are sometimes globose, and sometimes form deformed nodules, at first very minute and afterwards gradually larger. Thus we have before our eyes copious examples of all the primary stages. This evolution might be easily explained by means of figures, but it is also sufficiently intelligible without them.

In the genus *Leptogium*, the thallus has a distinct cellular cortical layer. A crowded, papillose, or at length dactyloid isidium is observable on the upper surface (hence the name *pichneum* of a variety of *Leptogium tremelloides* in Ach. Syn. p. 343). This, in like manner, affords conspicuous examples of the initiatory thalline evolution by means of such gemmules. And in this genus isidioferous thalli occur more frequently than in the genus *Collema*. These isidiose papillæ or gemmules are very laxly fixed on the thallus, and are readily separated by a slight touch. Here, however, the stages of the evolution are less simple, by reason of the externally cellulose texture of the thallus.

It is also worthy of observation that isidioferous thalli

* Translated from 'Flora,' Sept. 10, 1868.

scarcely ever produce apothecia. They appear to be multiplied by the Nostoc-like gemmules excreted from the upper surface of the thallus, and not by any sexual propagation. And probably fertile thalli are only evolved from spores.

We may therefore conclude that the genus *Nostoc* of modern algology, in part at least, if not entirely, may be regarded as the initial or metamorphic states of the *Collemata*.

I have already added to the family of the Lichenes various *Scytonemata* and *Sirosiphones*; and, indeed, certain *Glœocapsæ* (such as *Synalissa picina*, *S. meladermia*, *Collema evilescens*, and *Bryophagus Glœocapsa*, Nitschk., optime forte dicendus *Glœocapsa bryophaga*) may be added.

The lichenose nature of these vegetations can only be manifested by the fructification. I have formerly stated that the various sterile states of them which are so abundantly met with are analogous to the *Lepratiæ* of the family of the Lichenacei, and that Lepratiæ never pass into typical Lichens producing apothecia, but always remain leprose and sterile. In like manner the Nostoc-like and analogous states of the *Scytonemata*, *Sirosiphones*, and *Glœocapsæ* remain in their peculiar inferior grade, atypical and sterile, without any evolution into a more perfect and fertile condition. It may be also suspected that not a few other vegetable forms at present received into algology ought to be transferred to lichenography; but a fuller experience is needful to determine how far this is true.

On the sandy roads about Paris and elsewhere in France I have observed that in a rainy season a small Nostoc often quickly springs up, and in the selfsame localities *Collema pulposum* in a sterile condition afterwards occurs; and we may hence probably infer that this derives its origin from the Nostoc. But the evolution of this adult Lichen, as of all others, is slow.

It may also be noted that the age of Lichens may be best determined in cemeteries, where they abundantly occur on sepulchral stones bearing the dates of their erection, and upon which, no doubt, the Lichens, everywhere abundant, speedily disseminated themselves. Thus the specimens would coincide in size with the varied ages of such stones. For example, in the cemetery outside the city of Helsingfors, I have noticed that it required a period of twenty years for a Lichen (a common *Physcia*) to attain to a moderate or adult size: consequently their growth must be excessively slow.

XLVI.—*On* Hyalonema Schultzei *and on* Eurete.

By Dr. C. Semper*.

Hyalonema Schultzei, S., has the size and form of *Euplectella aspergillum*. The fibres of the roots, which are either smooth or toothed, divide themselves towards the body of the sponge into separate tufts, which spread in the interior as well as on the surface of the sponge itself, and here bear a similar relation to its framework as the fibres of the roots of the *Euplectella*. Cruciated spicula of very varied forms then unite with those longitudinal lines of fibres, thus forming a network of a more or less compact tissue, which is crossed in all directions by the large canals of the sponge. The comparatively wide expirating oscula range irregularly around the whole sponge; near them are often tufts of fine silk-like fibres. In some parts of the somewhat injured surface there is a fine tissue forming wide rectangular meshes. The whole network of the sponge is formed, as is the case with all real species of *Hyalonema*, of unconnected fibres or cruciated spicula, though sometimes single spicula blend together, and thus point at the origin of the connected siliceous network of the *Euplectella*.

The forms of the numerous separate siliceous bodies call to mind those of *Hyalonema Sieboldii*, Gray, from Japan. At the upper end of the sponge a new species of *Ægа* had settled in an enlarged canal; this species, widely differing from that of *Euplectella*, I have named *Ægа hirsuta*, on account of its hairy limbs.

The genus *Eurete* was established on a coral-shaped sponge, the cylindrical and hollow branches of which grow together. The wide oscula at the extremities of its branches seem to be the expirating, the small holes between the network forming the lining of the tubes the inspirating orifices. The tissue of the lining of the tubes, being of about one millim. thickness, is formed of a rather compact net of fine siliceous tubes, which sometimes are blended irregularly, but sometimes cross each other very regularly, thus forming a network including rectangular meshes. There do not appear to exist separate cruciated spicula; but frequently the cavities of the connected cruciated fibres remain independent of each other, so that often two or three adjoining though unconnected cavities are cemented by the common siliceous mass. The extraordinary size of the cavity of the central fibres in these siliceous tubes is surpri-

* Translated by Frau Anna Semper, from the Transactions of the Society for Medical and Physical Sciences at Würzburg, 13th Session, July 18, 1868.

sing; for its diameter is often six times as large as the thickness of the coating. Unfortunately the only specimen known has been much bleached, so that it is impossible to say whether the almost total absence of all detached siliceous bodies may be looked on as a distinguishing character of this genus. Judging from the structure of the tissue, this sponge might perhaps be ranged in the same genus with *Farrea orca*, Bowerb.; but as only fragments are known of the latter, which possibly might belong to *Euplectella cucumer*, Owen, in whose roots they were found, for the present *Farrea orca* and *Eurete simplicissima*, S., must be considered different species. A careful examination of the tissue of *Euplectella cucumer* would settle the question. Detailed descriptions will shortly appear in the 'Zeitschrift für wissenschaftliche Zoologie.'

XLVII.—*Note on* Hyalonema Schultzei, *Semper*.

By Dr. J. E. Gray, F.R.S. &c.

After studying the translation of Dr. Semper's description of *Hyalonema Schultzei* made for me by his wife, Frau Anna Semper, to whom we are indebted for the beautiful figure of the Philippine *Holothuria*, and considering the additional information that Dr. Semper has most kindly communicated to me personally during his stay in London, I have come to the conclusion that it is very doubtful if *Hyalonema Schultzei* really belongs to the genus to which Dr. Semper refers it, and if it is not rather a true Sponge, a species of *Euplectella*, or, may be, of a new genus of sponges very nearly allied to *Euplectella*. Unfortunately only a single specimen has as yet been obtained, and it is without any polypes, if it ever had any, which I doubt. It certainly differs in many most important particulars from what I have given in my paper in the October Number of the 'Annals' as the character of the group Hyalonemadæ.

The long spicules of *H. Schultzei*, which have been compared to the spicules of *Hyalonema*, are like those of *Euplectella*; they have a cup-shaped knob or anchor at the tip, and a series of recurved spines on the part near the tip, like those figured by Owen (Linn. Trans. xxii. t. 21. f. 6 & 7.) These spicules agree with those of both the species of *Euplectella* known, and are quite unlike those of *Hyalonema*, which are always imperfect at the end, without any anchor or projecting spines, but with rings of small spines directed towards the middle of the spicules, as described in my late paper.

It is said that the upper ends of the long spicules of *H.*

Schultzei spread over the surface of the barrel-shaped body of the sponge, and do not form a conical pencil like that which is inserted into one of the sides of the cup-like sponge that is sometimes parasitic on the tip of the *Hyalonema* from Japan.

The body of *H. Schultzei* is somewhat like in form, and resembles in texture, the body of *Euplectella cucumer* of Prof. Owen. Indeed *H. Schultzei* of the Philippines seems to differ chiefly from *Euplectella* from the same country in the long spicules with the recurved spines and cup-like anchor termination being directed from the body, as if they formed a stem by which it was anchored in the mud or sand, instead of being bent upwards towards the upper part of the tubular sponge, forming a ruff or fringe round its body, as they are generally seen in the more perfect specimens received from the Island of Zebu.

We are very imperfectly informed how the *Euplectella aspergillum* is attached to the bottom of the sea in which it grows. Most specimens from Zebu have a greater or less quantity of dry mud enclosed in a large number of small fibres at the base, as in Prof. Owen's plate (Linn. Trans. xxii. t. 21. f. 1), looking as if the sponge had grown with a small, more or less expanded, circular disk, formed of the spicules, on the mud, which with some mud is artificially moulded by the collectors into the form in which we generally receive them; but this disk seems a very small and insecure means of attachment at the bottom of the sea, however quiet the water in which they live may generally be.

Prof. Owen, when describing *Euplectella cucumer* (Linn. Trans. xxii.), observes that the specimen had fortunately been preserved along with the foreign bodies to which it was attached by the terminal filaments; such a mode of attachment may now, therefore, be added to the generic characters of *Euplectella* as defined *l. c.* p. 117. On the plate is figured the "foreign sponge and other bodies to which it is attached" (p. 123); and in the figure some of the long "barbed filaments with their terminal anchors" at the base of the barrel-shaped body of the sponge are bent up like those seen on the specimen of *E. aspergillum* from the Philippines, while others bend down so as partly to cover the mass of foreign bodies above referred to, to which it is attached.

Since I have read Dr. Semper's paper, and have discovered that *Hyalonema* lives with its siliceous spicules sunk like roots in the sand or mud, it has occurred to me whether *Euplectella* may not use the elongated, barbed and anchor-ended spicules sunk in the sand for the same purpose, or that they may surround a mass of foreign bodies, like those figured as at-

tached to *Euplectella cucumer* in the plate above referred to, as a mooring to keep them in their place at the bottom of the sea —that the collectors artificially bend up, for the purpose of packing, the barbed anchor-bearing spicules round the body of the sponge—and that what Dr. Semper considers the stem, which he compares to the coil of *Hyalonema*, may be only a bundle of the spicules which it has in common with other species of the genus *Euplectella*.

The consideration of these questions is important, not only as regards the use of the peculiar barbed spicules of the genus *Euplectella*, but also in comparing them with the spicules of *Hyalonema*, and particularly as regards the relation that *H. Schultzei* has to the sponge *Euplectella* or the coral *Hyalonema*, to which it has been referred. It is important to settle this question before we use this animal as an argument to determine the situation of the genus *Hyalonema* in the general system of nature.

Dr. Semper objects to my remark, at page 275, that "the coil had lost its bark and animals," like the specimens that are sent from Japan and dredged up in Portugal—observing that "it never had any animals," which is quite consistent with the theory of its being a sponge nearer to *Euplectella* than to *Hyalonema*, and proves, if my theory is correct, that it cannot belong to the latter genus.

Of all modes of introducing ambiguity and confusion into science, none is half so effectual as the use of ambiguous names. One name for one animal is the first principle of natural science. Dr. Semper states that it cannot be a *Euplectella*, as the body of that sponge is reticulated, the longitudinal spicules being crossed in the bundle by horizontal and oblique ones, while the body of *H. Schultzei* is only formed of longitudinal spicules without any transverse ones, and only kept in their place, so as to form an elongate oval cup, by the sarcode. All these particulars are utterly at variance with all the characters that I have given to the true Glass-rope or *Hyalonema*, and so much more similar to those that belong to *Euplectella* that I am induced to propose for the present that it be regarded as a new genus of sponges of the family Euplectelladæ, for which I would propose the name of *Semperella*. It may appear precipitate to propose a generic name for a sponge that I have not seen; but it is absolutely necessary; for already so many things have been called *Hyalonema* that it requires the greatest attention, when one sees the name mentioned, to know what part of the Glass-rope the writer is speaking of, or if he is speaking of a sponge not having the slightest affinity to the Glass-rope.

If this theory is correct, it will add another synonym to the genus *Hyalonema*, which already has many significations.

1. *Hyalonema*, Gray, Brandt, Bocage. The coil and polypes. The sponge, regarded as parasitic, named *Carteria*.
2. *Hyalonema*, Valenciennes, Milne-Edwards, Max Schultze, Wyville Thomson, Perceval Wright, Huxley. The sponge and coil, the coil being regarded as a part of the sponge (*Carteria*, Gray). Polype regarded as a parasitic species of *Palythoa*.
3. *Hyalonema*, Bowerbank, W. Carpenter. The sponge, coil, and bark. The bark or polypes regarded as a skin of the coil and sponge, which they consider part of the same organization.

Excluded Species.

4. *Hyalonema*, sp. (*boreale*), Lovén, Wyville Thomson. A sponge (*Ficulina*, Gray) belonging to the family Halichondriadæ.
5. *Hyalonema*, sp. (*boreale*), Bocage = a sponge (*Lovénia*, Bocage) belonging to the family Tethyadæ.
6. *Hyalonema*, sp. (*Schultzei*, Semper) = *Semperella*, Gray. A sponge of the family Euplectelladæ.

No doubt great part of this confusion has originated in the very strong predisposition of zoologists and physiologists to believe that siliceous spicules can only be secreted by Protozoa or sponges, and plants, as Diatoms, the grasses, *Equisetum*, &c., though M. Haime says that he discovered siliceous spicules in the bark of *Leitopathes*, and Dr. Wyville Thomson says that silica is present in the axis of *Gorgonia*, and Dana that it forms 23 per cent. of the chemical constituents of certain Madrepores.

Semperella may be thus defined:—

A tubular vase-shaped sponge, with the tube closed with a convex lid, and the wall of the tube formed of elongated, slender, subcylindrical, thread-like, siliceous spicules, which are kept in the vase-like form by the sarcode. The base contracted, some of the thread-like spicules of the tube and others being produced into a stem, which is sunk in the mud. The radical filaments barbed near the end, and with a cup-shaped anchor at the tip.

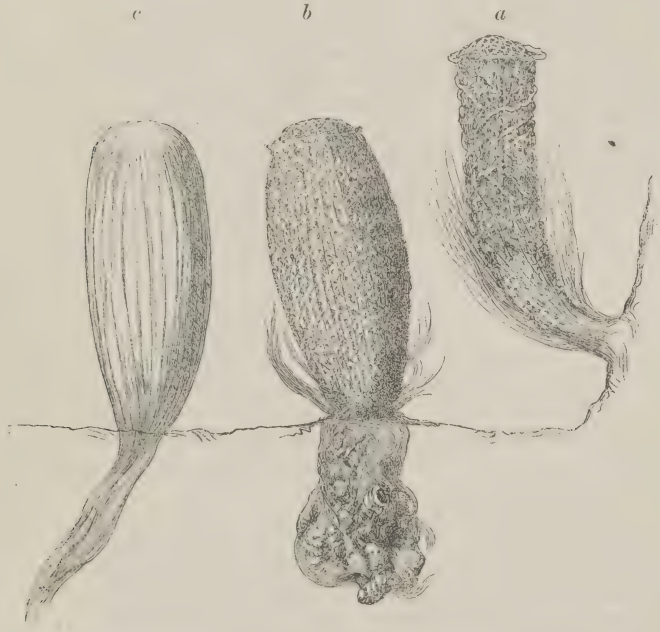
Semperella Schultzei = *Hyalonema Schultzei*, Semper.

The different shape of the body of *Euplectella aspergillum*

and of *E. cucumer* may indicate that they grow in different situations and circumstances.

E. cucumer most probably grows in the mud, kept in its place by a mooring of stones, as figured in Professor Owen's plate.

The curved form of *E. aspergillum* would lead one to believe that it most probably grows on the side of a perpendicular rock; but I have no proof that this is the case, except the form. If it grew from a horizontal surface, the top of the tube or cloaca would not be uppermost and the *Euplectella* in the upright position natural to all sponges and other animals and plants that live on the bottom of the sea.



a. Euplectella aspergillum, Owen. *b. Euplectella cucumer*, Owen.
c. Semperella Schultzei, Gray, from an outline by Dr. Semper.

This sponge cannot be the young state of *Euplectella aspergillum*, which is also from Zebu. We have a young specimen of that species, not more than 2 inches high, in the British Museum, which was sent with the adult. It is nearly cylindrical, and has distinct horizontal bundles of spicules across the longitudinal ones, as in the adult state of the genus, which are entirely wanting in *Semperella*.

BIBLIOGRAPHICAL NOTICE.

Dei Funghi sospetti e velenosi del Territorio Sienese. Per Francesco Valenti-Serini, M.D. Pubblicato sotto gli auspicii e per cura della Reale Accademia di Medicina di Torino. Torino, 1868. [*On the Suspected and Poisonous Fungi of the Territory of Siena.* By Dr. F. Valenti-Serini. Oblong folio. With 56 coloured plates.]

This very important contribution to cryptogamic botany is from one who has devoted many years of study to the discrimination of the different species of Fungi, chiefly with a view to determine which are those safe for the use of man as food. Dr. Valenti-Serini is the author of many works upon mycology, one of which is a general "Flora Micologica" of the Sienese territory, in two large folio volumes. Upper Italy is a country in which these plants are abundant and extensively eaten, and where accidents from the employment of poisonous ones by mistake are not unfrequent. Hence the interest attached to the selection of those that are safely edible. In a former work the author embraced the whole of the fungi, edible and poisonous, and reproduced them in relief, in terra cotta, coloured after nature. This work also was a mycology applied to hygiene and toxicology, and was prepared primarily to teach his countrymen which species and varieties are to be selected, and which to be rejected.

After the manuscript of the present volume, accompanied by the drawings (now very carefully reproduced in fifty-six coloured lithographs), had been presented to the Academy of Medicine of Turin, an elaborate report upon it was laid before the Academy by Professor Antonio Garbiglietti, which pointed out the great value of Dr. Valenti-Serini's manuscript, and recommended its publication; besides which, terra-cotta facsimiles of these dangerous fungi, and the drawings also, have been placed in a cabinet in the museum of the Academy, in order that they may be consulted and studied by those who resort to this museum.

We will give the title of Dr. Garbiglietti's report below, by which it will be seen that he enhanced his services to botanical science by accompanying it with an extended Catalogue of the Fungi of the neighbourhood of Turin and the whole of Upper Italy*. This catalogue embraces 500 species, and, besides other matters, gives the places of their growth and their qualities. It is a valuable work, and well deserved to be published by the Academy in a separate form†.

* Intorno all' opera manoscritta del Dr. F. Valenti-Serini, sopra i Funghi sospetti e velenosi del Terr. Sienese, Relazione del Socio Dott. Collegiato Cav. Antonio Garbiglietti. Coll' aggiunta di un Catalogo compilato per cura dello stesso Relatore. Torino, 1864.

† Catalogo delle principali Specie di Funghi crescenti nei contorni di Torino ed in altre Provincie degli antichi Stati Sardi di Terra ferma, disposte secondo il Sistema Micologico di Fries, compilato per cura del Dott. Coll. Cav. Antonio Garbiglietti, M.D. Torino, 1867.

The great object of Dr. Valenti-Serini, which has instigated his labours and stimulated him to persevere in them, has been to avert the sufferings occasioned by using these deleterious cryptogams as articles of food. Although in our islands fungi are by no means so commonly and so indiscriminately eaten, it is reported that the Society of Arts is making efforts to show that, with some exceptions which are easily identified, most of the fungi of England are safe articles of diet; so that it seems likely their use may be extended. Those who may be induced to consult this excellent work of an Italian physician, of great and long-continued knowledge and experience, will not be at all encouraged in this view with respect to fungi said to be sanctioned by the Society of Arts. Indeed it may be safely asserted that, except in the case of the well-known and very distinct species universally found to be edible and wholesome, they will receive at Dr. Valenti-Serini's hands every kind of discouragement.

This is not, perhaps, the proper place in which to dwell upon this momentous hygienic question; nevertheless it seems desirable to state some of the results obtained by Italian botanists. Dr. Valenti-Serini goes so far as to say that such are the changes these plants undergo in their brief existence, and such the slight and fleeting nature of the peculiarities which distinguish one species from another, that it is often exceedingly difficult, if not impossible, to discriminate the poisonous from the wholesome. And Dr. Garbiglietti states that circumstances influencing the vegetation (such as soil and season), he considers, may impart poisonous properties to fungi usually regarded as edible. This may in some measure account for the diversity of opinions held with regard to the qualities of one and the same species in different countries. *Agaricus necator* may be taken as one example. Dr. Valenti-Serini takes the names of *necator* and *torminosum* as in themselves suspicious; and Bulliard, Schæffer, Roques, and Larber call it poisonous. Still Letteillier says he has eaten it without detriment; and Venturi states that in his province of Brescia it is eaten; yet it must be confessed that it is there the custom to boil it in a large quantity of water, when it is quite innocent. It should be known that the boiling of poisonous species and other modes of cooking deprive them of their poisonous qualities, which are probably volatile. If, as the author conjectures, these essentially consist in the presence of prussic acid, the fugacious nature of the poison may be readily conceived. *Boletus chryseuthereon*, the subject of plate 53, is declared by Cordier to be innocent; but both Roques and Paulet prohibit the use of it.

Every fungus is produced from a spore, as every plant is derived from a seed. The aërial portion, which is commonly called the fungus, is not a plant, properly speaking, but a more or less compound fruit, formed of many parts.

After a comprehensive and learned introduction, in which most questions of interest relating to fungi are briefly discussed, the author passes to a description of the species and varieties which are

depicted upon the fifty-six fine plates. Some of these may be regarded as new to the Italian flora, or very little known—for instance:—

1. *Amanita Vitoni.*—This fungus was found for the first time by Dr. Vitoni, of Pistoia, towards the latter end of the last century, and described by him in a memoir addressed to the Academy of Georgofili of Florence. Dr. Vitoni witnessed some dreadful cases of poisoning occasioned by this fungus. Dr. Valenti-Serini regards it as a variety of *Amanita bulbosa viridis*, which has the laminæ rosy, and which he arranges in a subsection named *pseudo-Amanites.*

2. *Amanita terrea.*—Found by the author in 1839; also a *pseudo-Amanite.* Regarded by Chellini as suspicious.

3. *Amanita fulva*, which he has placed among the suspicious.

4. *Amanita cinerea.*—Rejected by the peasants.

5. *Agaricus fulvaster*, or *Amanita Trompeia formosa.*—To this handsome variety the 5th plate is dedicated. It may be a variety of *Agaricus vaginatus.* The peasants regard it as suspicious.

6. *Agaricus plumbeus* or *Amanita Terrachinia plumbea.*—Of this also the author is uncertain whether it should be retained as a variety of *Agaricus vaginatus.*

"Mycologists in treating of *Agaricus vaginatus* have restricted it to two varieties—*livida* or *plumbea* and *spadicea* or *fulva*; and it is disputed which of these is good to eat. DeCandolle, Chevalier, Cordier, Descourtilz are of opinion that they are esculent without distinction; Persoon and Pico that they are deleterious and decidedly poisonous. The Italian mycologists, as Venturi and Vittadini, declare them to be innocent, and maintain that in the Bresciano they are commonly used. These last, who are of great weight with our author, recommend the adoption of those only of the variety having the leaden colour, and the rejection of those of nankeen colour, because this variety may be sometimes confounded with some variety of *Agaricus pantherinus.* The French say they are sold in the Marseilles market." This is a good instance of the uncertainty which surrounds the safe discrimination of some species and varieties.

7. *Volvaria Corticelli.*—Discovered by the author in May 1862, and believed to be a new species. It appears in plate 8 in all its aspects. Its disgusting odour has led him to suspect its qualities. It is very beautiful, and is dedicated to Prof. Alessandro Corticelli.

8. *Agaricus perlatus.*—Found in 1862 by the author, and thought by him to be a variety of *Agaricus pantherinus.*

9. *Agaricus margaritiferus.*—Found in the same place as the last. The author is inclined to regard this also as a variety of *pantherinus*, and on this ground deserving to be rejected.

We shall be glad if this brief notice should draw the attention of English botanists to the writings of Dr. Valenti-Serini.

MISCELLANEOUS.

Acclimatization of Parrots at Northrepps Hall, Norfolk.

[At the recent Meeting of the British Association, the Members, among other invitations, were invited to pay a visit to Northrepps Hall, the residence of the Dowager Lady Buxton. While partaking of the hospitality provided by the accomplished hostess, the guests were delighted and astonished by the parrots that darted in and out among the trees or flew over their heads across the lawn, their brilliant plumage glancing in the radiance of the setting sun. After tea, Mr. Charles Buxton, M.P., read the following paper. We are sorry to learn that these birds, which at one time amounted to nearly fifty, have been reduced now to some twenty-four, owing to the vicious propensity of gamekeepers and so-called sportsmen to wantonly destroy every stranger that may come across them.]

I have undertaken to tell you a little about the experiment that has been tried here of letting parrots fly wild about the place; but though it has been a source of great interest and amusement to us, I much fear that there is very little to relate that could be thought worthy of the attention, even in their holiday moments, of an Association for the Advancement of Science. Nor can I honestly say that the attempt to acclimatize these birds (that is to say, to establish them as an addition to our English fauna) has in that respect been attended by success. It is true that they have several times made nests, and on five of these occasions the young have been brought to maturity; and were it not "for those vile guns," the birds would flourish extremely; for illness and death from natural causes would seem to be almost unknown among them. But, unhappily, they share in many of the characteristics of human nature, and in this one, above all, that they do not know when they are well off, and every now and then they are seized with a desire to see the world, and take flights to a distance, twelve or fifteen miles perhaps, and sometimes much more; and then they are almost sure to fall a prey to some gamekeeper or lad who is keeping crows, and who is astonished by seeing these brilliant apparitions among the trees. As regards their breeding, a pair of cockatoos led the way by most unsuccessfully attempting to make a nest in one of the chimneys; before it was half finished it gave way, and the nest and cockatoos fell to the bottom. It being summer time, they were only discovered after spending a day and a night among the soot, and when they were brought out they looked like two dwarf chimney sweeps. They persevered, however, and made another nest in one of the boxes that had been hung against the gables of the house in hopes of such an event. They laid two eggs; but though the hen cockatoo sat most perseveringly till September, it was all in vain—the eggs were addled. Afterwards a pair of green parrots, a cock of the Amazonian and a hen of the Honduras breed, made a nest in one of the boxes, and brought up a young one; but when he was

nearly fledged, one of the cockatoos thought it right to murder him. The year after, the same pair brought up two children, and it was really a beautiful sight to see the family party flying about, always together, and living on the most loving terms; but the mother and her eldest son both, unhappily, were shot. Afterwards one of the common white cockatoos and the hen Leadbeater (a very large rose-coloured cockatoo) dug out their own nest in the rotten branch of an acacia tree, laid two eggs, and brought up the young birds. These hybrids are very handsome, but do not resemble either of the parents, having beautiful crests of a red-orange-colour. Otherwise they are perfectly white. The parent birds were so pleased with the success of this experiment that last year they repeated it, and brought up three young ones, thus making up a flock of seven with the two firstborn. Unluckily one of them was shot at in the winter, and came home severely wounded; after which the other birds would not permit him to associate with them, and he always lived in a bush near the house, quite apart from the rest. One day I moved him into the garden, upon which some of the other cockatoos (not, however, his own relations) fell upon him the moment my back was turned, and killed him—one of those traits of character which, as I said just now, these birds, and, in fact, most wild animals, share with human nature in their general dislike of cripples. Another of them was also injured; so I took him away to Surrey, where, in spite of his broken wing and broken leg, an old cockatoo befriended him, and treats him as her own son. This year we hoped that the same pair would nest again; but unluckily, a pair of grey parrots anticipated them in the possession of the hollow branch, and, having made a nest in it, brought up two young grey parrots, and which are afflicted with awful tempers. The maternal instinct of another pair of grey parrots took a very absurd form this year. A cat made her lodging in one of the nest-boxes, and brought up her kittens in it, and two of the grey parrots, who had not been industrious enough to lay eggs and have a family of their own, were seized with the idea that these kittens were their children. They kept up a constant warfare with the old cat; and whenever she left the box, one of them used to get in and sit with the kittens, and they were constantly in close attendance, even when the mother cat was at home. When the cockatoos I have spoken of had their nest in the acacia tree, it was very ridiculous to see the extravagant interest taken in the matter by the others of the same species. They used to sit most of the day on the branches, just above the nest, and whenever the parent bird flew out, she was attended by a troop of the others, screaming horrible acclamations in her honour. There is an immense deal of originality about this race of birds. They have none of the common-place humdrum mediocrity of birds in general. Their curiosity is unbounded, and they evidently look on man and his doings with the keenest interest, mingled with surprise, and with, perhaps, just a *soupçon* of contempt. There is, moreover, strongly marked individual character among them. No two of them behave exactly in the same manner. I think

the large white cockatoo with the broad white crest is the most intelligent of the lot. I had one of them whom I wished to keep chained to a perch; but though a first-rate London locksmith tried everything his ingenuity could suggest, the cockatoo beat him utterly. Without breaking it, he contrived to open the ring or other contrivance for holding him, with his beak, though one or two of them must, one would have thought, have required great study to understand.

The experiment of acclimatizing parrots has been tried on a somewhat large scale. We have had African, Amazonian, and Carolina parrots; Rosella parroquets, large Bengal parroquets, four species of cockatoos, and two of lories. The lories are magnificent birds, with their scarlet bodies and very long wings and tails of rich metallic green. Curiously enough, however, they are far less seen than any of the others, as they almost always sit buried in the thickest foliage, and have none of the sensibility and intellectual excitement of the cockatoos or parrots. In fact, however, all these birds vanish completely out of sight during great part of the day; many of them, indeed, live in the woods at a distance from the house; but even those who have selected the trees in the garden for their residence would not easily be discovered. You would have supposed that at any rate the white cockatoos would be visible anywhere; but the inclination of all animals is to slip out of the sight of man, and with the shadows of the trees upon them an unpractised eye would rarely discover them. In the morning and evening they come to feed upon hemp-seed, and bread and milk, which is hung in a basket from a tripod; and then, I can assure you, the groups of them are sometimes most beautiful.

Lately we have had great losses, so many have flown away and been shot; but I will read a memorandum which I put down one day, a couple of years ago, of the scene I was watching, and which recurred morning after morning as I sat reading in my study at my house in Surrey. "The parrots' breakfast having been put in the basket, a pair of white cockatoos, who had been anxiously watching the proceedings from the tree above, swooped down and set instantly to work. A Bengal parroquet, with long green wings, presently comes skimming up and flutters for a few minutes almost perpendicularly in the air, exactly in the attitude so often represented by Mr. Gould in his 'Humming-Birds,' with the head and tail curved inwards, and the wings extended. Two or three rose-coloured cockatoos follow, and hang about on the tripod, but do not venture to take their places on the edge of the basket while their fiercer brethren are at work. But presently one of the huge white cockatoos, with yellow crests, comes swinging heavily down over the lawn, putting all the lesser ones to flight in a moment; but they soon gather round again, and a lory, resplendent in red and green, darts through the air, and lights on the top of the tripod, his burnished hues contrasting well with the pure white of the cockatoo below; and the group is completed by a Cornish chough, whose glossy blue-black plumage and orange beak and legs are not the

least striking of their costumes. He always at once engages in a fierce strife with his rivals; and his long beak gives him the advantage over them."

I can assure you, ladies and gentlemen, that a spectacle of this sort, which I have witnessed hundreds of times, is one of exquisite beauty, especially in a sparkling winter's morning, with the snow on the ground, when the colours of the birds seem peculiarly gorgeous. Nor do they appear to be injured by the cold: the grey parrots have the sense to get into a house that was built for shelter to them; but none of the others can ever be persuaded to enter it, and live in the woods the whole year through. But even the winter before last, when the thermometer in my neighbourhood fell six degrees below zero, though one cockatoo unaccountably disappeared, all the rest appeared to be as full of life and spirits as possible. In fact, so long as birds are well fed, and are in good health, I do not believe that cold is fatal to them. Their migration depends altogether on food, and not on the fear of cold. Even the delicate little long-tailed titmouse, and the still more delicate little golden-crested wren, and numbers of other seemingly tender birds remain with us the whole winter through without appearing to suffer. The fact is, that birds have such a wonderful great coat, such a dense mass of down below their feathers, and have also, if I am not mistaken, such a supply of caloric, much beyond that of other animals, that cold rarely kills them—though I do not mean to say that they like it.

It certainly, however, is curious that these African parrots, Bengal parroquets, and lories from the Philippine Islands have never appeared to suffer, even from our frost and snow. I may observe that the gardener declares that the grey parrots foresee a storm, and often take refuge in their glass-house before it comes.

Nothing can be more striking than the contrast between the plumage of the parrots when they first come, and its appearance after they have been flying about for a few weeks, when it acquires a gloss and glitter like that of burnished metal. Variety of food is not less essential to them than abundance, and they also require exercise. Some of them, who cannot fly, or who prefer moping at home, always look woebegone, and are gloomy and irritable, while the industrious Pollies who fly about and help to earn their own livelihood are cheerful, contented, and kindly. It is curious how clearly they have the idea of property and possession. An old parrot, who always sits in the ivy on an old wall, is just as indignant if any other parrot seeks to share in his part of it, as my cook would be if some of you insisted on taking up your residence in my kitchen. Generally, however, they pay the utmost respect to each other's prescriptive rights.

We usually have got our parrots from Mr. Jamrach, who has a shop near Wapping, and who buys all kinds of animals from the ships that come into the docks. His shop is a queer place, and well worth a visit. One day when I was there, he had in his little backyard a crocodile 12 feet long, and another (a baby crocodile,

which I bought and kept alive for some time) about 18 inches long, and sundry bears, lions, monkeys, racoons, and other animals; while all the rooms of the house itself are given up to birds—mostly of the parrot kind; and the screaming and shrieking is terrific. Every now and then there is a perfect avalanche of the little green parroquets from Australia; and on one occasion Mr. Jamrach had 3000 of them in his bed-rooms. Parrots that can talk fetch a high price; so we rarely buy them, as we don't want pets. Moreover they very soon lose their power of talking when they are out in the woods; but sometimes they learn to imitate other sounds. At my house in Surrey the jackdaws build in boxes placed for them in the gables; and a grey parrot who flies about has learnt to imitate them exactly, while one of the cockatoos can imitate the clucking of a hen so cleverly that no one would conceive that it was not the fowl herself. A large Amazonian parrot, who has been at Northrepps Hall for twenty years, used to be a first-rate talker. He it was who originated the plan of turning the parrots out; for having escaped from his cage, he remained in the oak and beech trees for nearly three months, and only came back when the winter set in, but looking so magnificent that the idea suggested itself of trying the effect of liberty on other parrots as well. After he returned, he amused us very much by walking up and down on the sill of the dining-room window, repeating the phrases of anxious entreaty that had been addressed to him by the maidservants to induce him to come in, exactly imitating their different voices as well as words. On one occasion he nearly frightened a poor woman out of her wits by suddenly plumping down on the top of her head as she was walking along the road. On two or three occasions, strangers, when approaching the house, have been perfectly astounded by hearing what they took for the voices of invisible human beings issuing from the trees over their heads. One of his favourite phrases still is, "I have no wife, but I have to care for my mother."

One of the young cockatoos that was born in the acacia trees disappeared last spring, but returned the other day in a beggarly and ruinous condition, having evidently been nearly starved, but soon recovered his good looks. It is curious what could have become of him, and how he found his way back after so long an absence. The same thing has occurred with others. One of the large cockatoos deserted my place in Surrey for several months, and was continually seen associating with a flock of rooks some miles away, but at length returned. On one occasion a flock of our parrots flew to a place full twenty-five miles away, and eleven of them were shot. Afterwards five cockatoos were shot all together in the same way.

It is curious what friendships arise between birds, some of which belong to different species. A parroquet and a green parrot were perfectly inseparable; and so, too, at my house in Surrey, I had at one time a flock of eleven grey parrots; but ten of them having got killed, the survivor associated himself with some cockatoos, and for the last few years has invariably flown about in their company.

One Carolina parrot was frost-bitten in the hard winter of 1860, and lost both her legs. She looked a deplorable object ever after; but a magnificent parrot took pity on her, and devoted himself to her in a most chivalrous manner, defending her from the attacks of other parrots who would have murdered her, cleaning her feathers, and generally sitting close to her side. The contrast was most ridiculous between the diseased old cripple and the splendid young knight who had this infatuation for her. After some years, however, the cockatoos made a combined attack upon her, a tremendous scrimmage took place, certainly not without the "din of battle," and it ended in the slaughter of the poor old bird.

They are very fond of the under gardener, who feeds them; and he is rarely to be seen at work out in the garden without one or two cockatoos sitting on his head or shoulders. Their arrangement of their hours is a very sensible one. Soon after dawn their voices may be heard from a distant wood, in which most of them sleep. They then come and wait for their breakfast; but the midday hours are always spent in sleep, after which they again seek for food, and come for their supper; but before they go to bed they, like rooks, devote themselves to a regular jollification, the parrots often flying round at a great height in circles, screaming with delight, while the cockatoos fly from tree to tree with their crests erected, shrieking at the top of their sweet voices, especially if they see people in the garden, which always is a great amusement to them. I must confess that some of them, if not all, are mischievous, especially in the way of picking fruit; but we think ourselves more than repaid by the animation they give to the garden, and the exquisite beauty of their colouring.

Note on Dr. Macdonald's Paper on the Dentition of Gasteropods.

By Dr. J. E. Gray, F.R.S.

I think that Dr. Macdonald has committed an error that is common to young naturalists—has mistaken an analogy for an affinity. The form of the lateral teeth of the odontophore is, no doubt, a good specific (and may be generic) character; but I think that Dr. Macdonald's table proves that it is not the character of a family. The character of a family should be derived from the consideration of the whole animal—its form, the form and development of the teeth, and the form of the shell and operculum; and not from any one character, such as the form of the lateral lingual teeth, especially if it brings together in the same family such a series of incongruous genera and separates nearly allied genera as they are separated in Dr. Macdonald's list. Therefore I cannot agree with him that "the lingual dentition appears to be the only appeal," or that the best means for arranging the genera and families is according to the form of the lateral teeth. I think, if any one will consult Dr. Macdonald's plate, he must perceive that the lateral teeth gradually pass from one form to the other; and I cannot conceive any reason why all the forms figured may not belong to the genera of one family.

Note on Pompholyx, *Lea, a new Family of Fluviatile Mollusca.*
By Dr. J. E. Gray.

Mr. W. H. Dall has lately described and figured the animal of the genus *Pompholyx* of Lea, a small freshwater shell found in the Sacramento River. The animal is peculiar from having "two pairs of eyes—one pair at the end of the long tentacles, and another pair situated on the inner base of the tentacles." "The shell is depressed, few-whorled, the last whorl the largest, without fold in the columella; inoperculate."

This genus has hitherto been arranged in *Lymneadæ* with *Planorbis*. Mr. Dall, in the 'Proceedings of the California Academy of Sciences' for 1866, proposed that, on account of the number of the eyes, it should be formed into a new family, which he calls *Pompholinæ*. The existence of the second pair of eyes is an anomaly in terrestrial mollusca, and requires confirmation. The black spots between the tentacles of some well-known fluviatile *Auriculidæ* have been mistaken for eyes. Probably this genus may prove to belong to the family *Auriculidæ*; at any rate, it has been wrongly arranged in *Lymneadæ*.

Dredging among the Shetland Isles.

To the Editors of the Annals and Magazine of Natural History.

Gentlemen,—Have the goodness to insert the following corrections of my last Report on Dredging among the Shetland Isles:—

Nucula tenuis. The words "probably *Nucula ægeensis*, Forbes," refer to this species, and not to *Leda pygmæa*. But Forbes's descriptions are by no means satisfactory; and, unfortunately, most of his types have been lost. His *Lima cuneata* may be the young either of *L. elliptica* or *L. Loscombii*—the character "testa æquilateralis" being applicable to the former species, and "auriculis inæqualibus" to the latter.

Cerithium metula. Having now had an opportunity of examining Mr. Hanley's shell, which he dredged in deep water off Villafranca, I am satisfied that it belongs to this species, and not to *Cerithiopsis Barleei*.

I accidentally omitted in the list *Pleurophyllidia Loveni*, Bergh, dredged by Mr. Barlee in Shetland, and mentioned by Forbes and Hanley as the *Diphyllidia lineata* of Otto.

To the list of Nudibranchs may be added *Lomanotus marmoratus* of Alder and Hancock. A specimen was dredged at a depth of about 80 fathoms off the Whalsey Skerries in 1864, and detected by my observant friend Mr. Peach; it was named by Mr. Alder. Mr. Norman also writes me word that the following may be added on his authority:—*Polycera ocellata*, A. & H., tidemarks, Balta Sound. *Eolis pustulata*, A. & H. (with *E. alba*, *Idalia Leachii* and *I. inæqualis*, *Dendronotus arborescens*), in 40–60 fathoms, St. Magnus Bay, and *E. Landsburgii*. These increase

the number of Shetland Nudibranchs to 26, and that of all the Zetlandic Mollusca to 359.

The total number of British land and freshwater species should be thus divided:—

Conchifera	15
Gastropoda	107

The numbers (47 and 75) given in the Report were those of freshwater and land species respectively.

In the list of Diatoms, *Sinciella minuta* ought to be *Surirella minuta*.

I remain, Gentlemen, yours faithfully,

J. Gwyn Jeffreys.

25 Devonshire Place, Portland Place,
15th October, 1868.

On the Occurrence of the Genus Anser *in the Peat and Gravel Deposits in Cambridgeshire.* By J. F. Walker, B.A., F.G.S.

Among the bones which I have obtained from the Cambridgeshire fens, I have detected the humerus of a species of goose. With the kind assistance of Mr. Dallas, I have compared this bone with those of the skeletons of geese contained in the valuable collection of comparative osteology in the York Museum; and it appears to agree in all its essential characters with the right humerus of *Anser ferus*. I am not aware of the occurrence of this bird in the fens having been previously recorded, although its presence there might have have been expected. The bone is of the dark colour proper to those found in the fens.

A more interesting discovery is that of the right humerus of a distinct and larger species of the genus *Anser*, obtained from the gravel deposits near Cambridge, which contain species of elephant, rhinoceros, horse, &c. associated with *Cyrena fluminalis* and existing land and freshwater shells (see a paper by Mr. H. G. Seeley in the Quarterly Journal of the Geological Society for 1866, p. 475). This bone is larger in every respect than the one which I have referred to *Anser ferus*; its total length is $6\frac{7}{8}$ inches, diameter of the shaft $\frac{9}{16}$ inch, greatest breadth across the proximal end $1\frac{1}{2}$ inch, and breadth of distal extremity $1\frac{1}{16}$ inch. The pneumatic foramen is not only relatively, but absolutely smaller than that in the humerus of *Anser ferus*. Dr. Buckland figures (Reliquiæ Diluvianæ, pl. xiii. figs. 9, 10) a fragment of the humerus of a bird from the diluvium of Lawford near Rugby, which he considers to have belonged to a species of *Anser*. The bone figured by Dr. Buckland seems to be nearly of the same size as that in my possession; but if we may trust the figure, its shaft had a rather stronger curve, and the structure of the proximal portion was not quite the same.

Euplectella.

A new importation of these beautiful sponges; they are offered under the name of "*Seekrebs-Nest* (that is, *Sea-Crab's nest*), which are only found on the Island of Zebu, and are imported from Manilla."
—J. E. Gray.

The Collared Snake (Coluber natrix) *in the Sea.*
By Dr. J. E. Gray, F.R.S.

It has been stated by several persons that *Sea-Snakes* are sometimes found in the European seas, and even on English coasts, as far north as the Orkneys, their appearance in the latter locality being accounted for by their having been carried there by the Gulf-stream, which might perhaps happen with some American species; but the specimens shown to me have all been the common Collared Snake (*Coluber natrix*), and I have been inclined to doubt the accuracy of the statements, as they were not well authenticated, and on examination were generally found to have come through two or more persons before they reached me. The other day the Secretary of the Montrose Natural History Society showed me a specimen of *Coluber natrix* which was taken up in a bucket in the sea, about twenty-five miles from the Naze on the coast of Norway. It lived some time aboard, and arrived alive at Montrose and was there put in spirits.

This Snake is aquatic in its habits, often found in ponds and ditches, where it goes to catch frogs, fish, &c. It has no near relation to what are usually called Sea-Snakes (*Hydridæ*). This *Coluber* may have been washed down by the floods into the sea, as the *Boas* are said by Guilding to be in the West Indies.

On the Jaw of Cylindrella. By T. Bland.

42 Pine Street, New York, 12th October, 1868.

My Dear Sir,—I have lately made an unlooked-for discovery, which I announce to you, to whom all are so much indebted for labours with reference to classification.

I find that *Cylindrella*, as well as *Macroceramus*, has a *jaw*, in both of much the same character. Lately I received several species either alive or in glycerine; and immersion in a solution of caustic potash enabled me with comparative ease to detect the jaw. Being very minute and delicate, I do not wonder at this having escaped notice. I had previously examined dead and dried-up specimens only of the *Cylindrella-Maugei* group.

I have both jaws and lingual bands of

Cylindrella sanguinea, Pf. Jamaica.
C. rosea, Pf. Jamaica.
C. brevis, Pf. Jamaica.
C. elongata, Ch. Jamaica.
C. gracilis, Wood. Jamaica.
C. Maugei, Wood. Jamaica.
C. trinitaria, n. sp. Trinidad.
C. bahamensis, n. sp. New Providence.

I shall publish this with figures; meantime I take pleasure in informing you, as I have Dr. Pfeiffer, through Mr. Crosse.

I am, my dear Sir,
Very truly yours,
T. Bland.

Dr. John E. Gray,
British Museum.

Remarks on the Development of Marine Fishes. By G. O. Sars.

It has long been supposed that the codfish deposit their ova at the bottom of the sea. M. G. O. Sars has recently shown that this

opinion is erroneous. These fishes deposit their spawn at the surface of the water, where the ova float throughout the whole of their development. The same naturalist has just made very similar observations upon various other species of fishes. He has ascertained, for example, that the mackerel (*Scomber scombrus*) lays its eggs at some leagues from the shore and at the very surface of the waves, where a great quantity of these fishes may often be met with engaged in spawning. With the ova of the mackerel, M. Sars has found those of six other species of fishes, one of which is the gurnard (*Trigla gurnardus*). The ova of the mackerel, like those of the cod, present at their superior pole a drop of oil, which diminishes their specific gravity so as to enable them to float at the surface. This drop remains during the whole period of evolution; and even after exclusion it is to be seen in the vitelline sac of the young fish. The young mackerel are recognizable by a sulphur-yellow spot placed behind the eye, which is still almost destitute of pigment.—*Nyt Magazin for Naturvid.* 1866; *Bibl. Univ. Bull. Sci.* 1868, p. 255.

On the Name Alcyoncellum. By Dr. J. E. Gray, F.R.S. &c.

Dr. Bowerbank, in a late paper in the 'Proceedings of the Zoological Society,' 1868, p. 132, objects to my using *Alcyoncellum* for a calcareous sponge. He observes, "From this quotation we should naturally imagine that all preceding writers who have referred to this genus, as founded by MM. Quoy and Gaimard, were wrong, and that it was originally established by M. Blainville in his 'Man. d'Actin.,' published in 1834, instead of by MM. Quoy and Gaimard in their 'Zoology of the Voyage of the Astrolabe,' published in 1830." I need not quote the observations founded on this statement. The law of priority, even, is liable to mislead unless writers who use it are well acquainted with the history of the subject, and the books written on it. The 'Manuel d'Actinologie' is a reprint of the article "Zoophyte," published in the 'Dictionnaire des Sciences Naturelles,' vol. lx., and bears date 1830. And MM. Quoy and Gaimard published four volumes of the text to the 'Voyage of the Astrolabe:' the first volume bears the date 1830, as quoted by Dr. Bowerbank; but the fourth volume, which contains the account of *Alcyoncellum*, bears the date 1834. So I use the name according to the "excellent and just rules" to which Dr. Bowerbank refers.

I admit that there is a great difficulty on the subject. M. de Blainville described and figured a calcareous sponge brought home by MM. Quoy and Gaimard under the name *Alcyoncellum gelatinosum*; it is a very curious Australian sponge, like many fossil species found in the Eifel. MM. Quoy and Gaimard do not figure this sponge in their 'Voyage,' but they figure a species of Venus's Flower-basket (*Euplectella*), which is in the museum at Paris (a siliceous sponge not bearing the slightest resemblance to the calcareous one), and call it *Alcyoncellum speciosum*. In the text they quote the generic character for *Alcyoncellum* from the article "Zoophyte" in the Dict. Sci. Nat., and then describe under the specific name the siliceous sponge

that does not agree in the slightest degree with the generic character, which is that of a cylindrical branched sponge. I can only suppose that they had intended to figure the calcareous one and forgot it, and then somehow mixed up the two sponges together; at any rate, there is no doubt that by the law of priority the name of *Alcyoncellum* belongs to the calcareous Australian sponge, as, I think, Dr. Bowerbank must admit.

To add to the confusion, M. Milne-Edwards, in the second edition of Lamarck's work, published in 1834, seeing that the figures and the generic characters in MM. Quoy and Gaimard's work did not agree, instead of giving a new generic name to the sponge figured, gave a new character to the genus *Alcyoncellum*, evidently taken from MM. Quoy and Gaimard's plate. Thus he lost the credit of establishing the genus that was afterwards named *Euplectella*, though in fact he did establish it under a name used for a different sponge.

On an accidental case of Monœciousness in Cœlebogyne.

By H. Baillon.

The author showed to the French Academy some monœcious branches of *Cœlebogyne ilicifolia*, Sm., bearing at the same time female flowers, ripe and entire fruits, fruits open to give issue to perfectly formed seeds, and, at their upper part, thousands of male flowers with the anthers full of pollen. The specimens formed part of a collection of Euphorbiaceæ sent from Australia for determination by Dr. F. Müller, and were collected at Rockhampton in the wild state.

The author remarks that the slight value of the genus *Cœlebogyne*, and the frequency of such anomalies in other genera to which its species might be referred (*Cladodes*, *Alchornea*, *Aparisthmium*), had led him to predict that, sooner or later, cases of hermaphrodism or monœciousness would be detected in this plant. This prediction was already fulfilled as to hermaphrodite flowers. The present demonstration of the existence of accidentally monœcious flowers gives, in his opinion, the last blow to the doctrine of parthenogenesis.—*Comptes Rendus*, May 4, 1868, p. 856.

Note on a Double Egg of a Fowl.

To the Editors of the Annals and Magazine of Natural History.

Gentlemen,—A friend, residing in the Cuddupah district, in the Madras Presidency, has sent me a boiled fowl's egg which contains a smaller egg with a shell. It had been cooked for his breakfast.

Eggs with a double yelk I have several times seen; but I have never seen or heard before of a perfect egg inside another: it therefore appears desirable that it should be recorded in the 'Annals.'

I am, Gentlemen,
Very truly yours,
J. Mitchell, Captain.

Ootacamund, Sept. 1, 1868. Sup. of the Madras Museum.

On the Lymphatic Vessels in the Tail of the Young of Batrachia.
By C. Langer.

Successful injections of this system of vessels facilitated the detection of many uninjected vessels, which could be traced from the ends of the injected portions of the tubes for a long distance in the tissue of the border of the tail. They not only permitted the arrangement of the whole system, but also the structure, connexion, and termination of the individual vessels to be investigated.

The author found that they have sharply marked, even outlines, without any indentations. Their appearance, as regards the constitution of the walls and the form of the nuclei, was hardly different from that of the fine blood-vessels. The limitation of the capillary lymphatic ducts by proper walls is easily ascertained in this object.

The capillary lymphatic vessels form a network, which in the smaller tadpoles, and in the fine border of the tail in larger ones, is diffused only in a single layer, but is overlaid on both sides with the network of blood-capillaries.

At the margin of the vascular region there are capillary lymphatic loops, of which some are remarkably narrowed; but even in the interior of the border, thread-like anastomosing branches are also met with so much narrowed that their complete impermeability seems a matter of course. This supposition is rendered still more probable by the discovery of similar portions attached to injected ducts. In this case they had also in part become coloured, but were only permeated as far as to the narrow part, usually furnished with a nucleus, where the coloration was limited to the form of a pointed narrow stripe.

Cæcal terminations of the lymphatic tubules also occur; these issue broadly from the wall of a capillary, and usually terminate quickly in a point, after producing a nucleus. It is possible that some of these extremities may be only apparently constructed in this manner, and really represent only one arm of a very narrow loop, the continuity of which cannot be traced; but appended portions which run out into a fine point, free on all sides, can hardly be regarded as anything but true cæcal terminations of lateral ramifications.

The signification of these, as also of the very narrow thread-like loops, must be genetic. In favour of this view is their similarity to the corresponding forms of the blood-capillaries, which are regarded and described as tubules in course of development. We must, however, in the author's opinion, know precisely what influence contractility and the treatment of the object may have upon the form of the finest vascular tubes, before we can with certainty regard all these vascular appendages as transition forms of new ducts.—*Anzeige der Akad. der Wiss. in Wien*, July 23, 1868.

Deep-Sea Dredging off Spitzbergen.

The Naturalists of the fourth Swedish Expedition to Spitzbergen have just returned to Stockholm, among them Smitt and Malmgren, the zoologists. Their collections are very considerable; they have brought up a good number of specimens from great depths, even from more than 2000 fathoms.—*Extract from a Letter from Prof. Lovén*, received Oct. 26, 1868.

THE ANNALS

AND

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[FOURTH SERIES.]

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Long Island HISTORICAL Society

XLVIII.—*On the Annelid Family of the* Maldaniea. By Professor GRUBE*.

QUATREFAGES gives this family its widest extent by including in it *Clymene*, Sav., and its nearest allies—not merely *Ammochares*, but also *Clymenidia*, *Arenia*, *Ancistria*, and *Clymenia* (which show a great resemblance to *Capitella*, *Notomastus*, and *Dasybranchus*) as "Clyméniens dégradés;" whilst Malmgren and Keferstein only include the first-mentioned genus, and even exclude *Ammochares*.

In this more restricted sense, therefore, the family embraces only genera of which the uncini are arranged in one (or two) transverse series, and is distinguished from all other families by several exclusive characters. There are a few Annelids which are characterized by a small and constant number of segments, such as the *Aphroditæ*, a portion of the genus *Polynoë*, Sav., *Hesione*, &c.; but among all these there are none in which the segments attain so great a length. In the Maldaniea their number never exceeds twenty-six or twenty-seven; and their length in the more fully developed examples at least equals, or even exceeds, their breadth. As the length increases from the two ends towards the middle of the body, some segments grow so considerably that they are twice or three times as long as broad, or even still longer. It is further to be remarked that the setæ, and the uncini seated beneath them, do not occupy the same position on all the segments, but are placed, on the anterior segments, in front of the middle, and on the rest near the hinder margin. This change of position probably occurs generally before the middle of the body; and the two segments on which it takes place show a less distinct division between them than the rest. Fre-

* Translated by W. S. Dallas, F.L.S., from the Jahres-Bericht der Schlesischen Gesellschaft für vaterl. Cultur, 1867, pp. 52–58.

quently the longer of the posterior segments are very much inflated behind by the elevation of the cushions on which the uncini are inserted, and may easily be torn away from the following ones, which commence with a thin part. All the segments, however, are not armed with bristles in the same manner: the buccal segment is quite destitute of bristles, as in the *Lumbricina*; the three following segments certainly bear setæ, but only a few uncini, or, instead of these, a pair of spinules, slightly bent at the apex; and the terminal segment and also usually from one to three (four) of the preceding ones, which are much abbreviated, are again destitute of bristles, although the latter generally have indications of the cushions in which the uncini are elsewhere inserted. In contradiction to other recent observers, Quatrefages describes uncini here also. In accordance with this, Quatrefages distinguishes three regions of the body in the Maldaniea, of which the middle one (*regio intermedia*) embraces the large and always preponderant number of segments furnished with setæ and complete rows of uncini. The uncini, always of an elongated sigmoid form, are distinguished from all similar ones by the circumstance that beneath the apex of their usually multidentate beak a band-like chitinous lamina is placed. The cephalic and caudal extremities are so arranged that, although they do not prevent ingress to the tube constructed by the animal, which is open at both ends, because this is much longer, they very conveniently protect it in its tube against an intruder. They are constructed on much the same plan as in the *Pectinariæ*, the dorsal surface of the buccal segment usually forming a firmer plate inclined forwards, and the terminal segment a similar plate inclined backwards, or a funnel, which correspond with the tube in diameter; in the *Pectinariæ*, however, the terminal plate belongs to several of the last segments, which together constitute a valve which can be turned downwards. The cephalic lobe itself is but little developed in the Maldaniea, and is probably to be sought only in the narrow longitudinal strip, projecting in front as a free lobule, which divides the vertical lamina of the buccal segment into two parts for a greater or less distance, and is marked off by a furrow on each side. In order to establish a genus of Maldaniea, therefore, both the ends of the body, of which the structure is so characteristic, must be preserved; and this, owing to the readiness with which these animals are torn, is frequently not attainable. Thus we know only the anterior halves of *Clymene torquata*, Leidy, *Leiocephalus parvus*, Quatref., and *Clymene ebiensis*, M.-Edw., and of the genera *Rhodine*, Malmgr., and *Mandrocles*, *Iphianissa*, *Neco*, and *Militta*, Kinb.; *Clymene*

spathulata, Gr., is probably described from two extremities not belonging to the same species, and therefore to be removed provisionally from the system; and *C. microcephala*, Schm., seems, from the figure, to be engaged in the reproduction of the anterior extremity; for the first segment in the figure bears bristles, and is therefore not the buccal segment, and the process in front of it by no means resembles the cephalic lobe of other Maldaniea.

For the purpose of a general revision of the arrangement of the genera, the structure of the cephalic and caudal extremities seems to the author to be particularly fitted; and he thinks that this arrangement may be most conveniently given in the following manner:—

1. The terminal segment is funnel-shaped, with the anus in the middle of the bottom of the funnel.
 a. In nearly all the forms belonging here the margin of the funnel runs out into points or teeth, as in the genus *Clymene*, Sav., which Malmgren divides into the genera *Rhodine*, *Nicomache*, *Axiothea*, and *Praxilla*, according as the vertical plate is dilated or not into a free margin, and according to the number of the segments, whether bearing or wanting bristles. Grube would unite under *Clymene* all the forms which have a margined vertical plate, and would therefore refer to it the *Axiotheæ* and *Praxillæ*, and transfer *Nicomache* to *Leiocephalus*. Of *Rhodine* the terminal segment is still unknown. The genus *Clymene* does not occur at all amongst the northern ones exclusively described by Malmgren; Kinberg limits it to *C. amphistoma*, Sav., and gives as its character, according to Savigny, twenty-five (probably twenty-eight) segments, and states that the three anteanal segments bear uncini, but the three segments following the buccal segment only setæ. But Savigny only indicates twenty-eight segments as not observed with certainty; and the specimens which the author found marked with this name in Ehrenberg's collection from the Red Sea are only in fragments (long cephalic and caudal ends), and therefore leave us in the dark upon this point, although they agree with Savigny's description so far that they may be regarded as identical; they show no uncini, however, upon the anteanal segments; whilst on the three anterior segments referred to, a small spine exists beneath the setæ which may easily have escaped Savigny; his figure at least shows the pit from which it issues.

If we laid as great a weight as Malmgren upon the number of the segments, a new question would arise, namely, whether it is requisite to consider only the total number of segments,

or also the number of the setigerous segments, in the establishment of new genera. To the author it appears to be advisable for the present to regard Malmgren's genera as mere subsections.

The genus *Clymene* would then include the following species :—

With 16 setigerous segments : *Cl. zostericola*, Quatref.
„ 17 setigerous segments : *Axiothea catenata*, Malmgr. (which possesses 4 anteanal segments), *C. modesta*, Quatref., and *Cl. lyrocephala*, Schm.
„ 18 setigerous segments, according to Quatrefages : *Cl. uranthus*, Sav. (Savigny ascribes to it 19 segments and 4 anteanal segments.)
„ 19 setigerous segments ; with 5 anteanal segments : (*Praxilla*), *P. prætermissa*, Malmgr., *P. arctica*, Malmgr., *P. Kefersteinii*, Kinb., *Cl. gracilis*, Sars, and *Cl. Muelleri*, Sars ;
with 3 anteanal segments : *Cl. lumbricoides*, M.-Edw. (Quatrefages indicates only 15–16), and *Cl. diadema*, Gr., n. sp. ;
with 2 anteanal segments : *Cl. digitata*, Gr., and *Cl. Œrstedi*, Clap.
„ 22 setigerous segments and 2 anteanal segments : *Cl. palermitana*, Gr.
„ 23 setigerous segments (?) and 3 anteanal segments : *Cl. amphistoma*, Sav.

Clymene diadema, Gr., discovered by Ritter von Frauenfeld in the Red Sea, like *Cl. lumbricoides*, which occurs not uncommonly at St. Vaast, presents longer and shorter teeth on the funnel; but these alternate almost regularly, one of the longer ones standing between every two or three very short ones ; the median strip passes through the vertical plate not, as in *Cl. lumbricoides*, as far as the middle, but nearly to the hinder margin, and does not project as a lobe at the frontal margin.

Clymene digitata, Gr., and *Cl. Œrstedi*, Clap., are very similar ; but the former, if the specimen examined was adult, is only one-third of the length of the other, its segments are much shorter and thicker to beyond the middle of the body, and the circular vertical plate has a distinct and entire margin; whilst in *Cl. Œrstedi* this is rather rounded pentagonal, and not distinctly marked, and has an emargination on each side behind.

From *Clymene* Quatrefages separates the genus *Leiocephalus*, which, otherwise agreeing with it, is almost or entirely destitute of a vertical plate. If we omit this last character, retain

L. coronatus, Quatref. and *Cl. intermedia*, Œrst., and add *Sabella lumbricalis*, Fab., it would seem desirable to accept this genus, which might be united with *Nicomache*, Malmgr., if we do not adhere to the number of twenty-two setigerous segments assumed by Malmgren in the generic character. *Cl. intermedia* must have fewer; *L. coronatus* has only thirteen. Of *Cl. ebiensis*, which is perhaps identical with *Cl. intermedia*, and of *Leiocephalus parvus*, Quatref., the posterior extremity is unknown: they cannot, therefore, any more than the above-mentioned *Cl. spathulata*, be numbered among the *Leiocephali*.

Near *Clymene* we should also have to place the genus *Johnstonia*, Quatref., some of the setigerous segments of which are furnished with richly sanguiferous cæca on the surface. In the only known species, *J. clymenoides*, Quatref., the last six setigerous segments are thus distinguished.

b. In two species of *Clymene* only do we find the terminal funnel smooth-edged and destitute of teeth, namely, in *Cl. urceolata*, Leidy, and *Cl. leiopygos*, Gr.

These might form a particular group (*Leiochone*); but they require that their examination should be repeated; it is a question especially whether the examined specimen of the latter has not a mutilated posterior extremity, as, contrary to its condition elsewhere, uncini and setæ exist even on the penultimate segment—and also whether the described anterior extremity, which is torn away behind, really belongs to this posterior extremity. In this case *Cl. urceolata* would be distinguished by the well-developed projecting margin of the vertical plate, which does not exist in *Cl. leiopygos*.

2. The terminal segment does not form a funnel, and the anus is situated on the dorsal surface.

In this section the genera *Chrysothemis* and *Sabaco*, Kinb., *Maldane*, Gr., and *Petaloproctus*, Quatref., should stand. In the first two the terminal segment, according to Kinberg, is not merely biannulate, but also divided into two parts in a longitudinal direction by two lateral furrows, and is cut off short beneath and produced above; the setæ are in part narrowly, and in part broadly margined, and in part furnished with denticulated margins; the uncini are stronger on segments 2–4, but already form small combs, which are broader further on; they persist on the penultimate segment. I cannot detect essentially distinguishing generic characters between these two genera in the description. Each of them is represented only by a single species, and that an exotic one—*C. amœna*, Kinb., and *S. maculatus*, Kinb. In *Maldane* and *Petaloproctus* the

above-mentioned lateral furrows at the posterior extremity are wanting, and a distinct posterior surface is developed upon it.

As regards *Maldane*, in which the terminal segment shows so close a resemblance to the buccal segment of *Clymene*, Malmgren has refuted the author's erroneous conception, according to which the former was the buccal segment, and the uncini stood above the setæ, and has established the correct generic character. The terminal segment has its apical surface inclined downwards and forwards, or nearly vertical and circular; the anus is situated above this; and the preceding naked segment, which, like the setigerous segments, is biannulate, shows no indications of lateral or ventral cushions. The vertical plate possesses a distinct margin, as in *Clymene*; and the setæ are partly bordered, partly finely denticulated.

Of the three species belonging to the genus, *M. biceps* (*Clymene biceps*, Sars) and *Cl. Sarsii*, Malmgr., are Scandinavian and Arctic, and *M. glebifex*, Gr., from the Mediterranean.

The genus *Petaloproctus*, Quatref., established upon a single species, is distinguished from *Maldane* partly by the want of a vertical plate, and by its much abbreviated, hemispherically inflated buccal segment, upon the anterior half of which, however, the median stripe representing the cephalic lobe is very distinctly marked in the form of a keel, and partly by a posteriorly inclined dorsal plate of the terminal segment including the anus itself.

This species is *P. terricola*, Quatref., from St. Sebastian, described as with 24 segments, of which 4 belong to the anterior, 14 to the median, and 6 to the posterior region of the body; the last two, however, are not readily distinguishable, as, according to Quatrefages, their segments bear setæ and uncini. The author believes he has met with the same animal at St. Vaast, but counts in it only 22 setigerous segments: the buccal and terminal segments are, as in all cases, destitute of bristles; and the latter does not appear to be preceded by any non-setigerous segments. If there be no error in Quatrefage's statement of the number of setigerous segments, his animal would possess in all 26 segments, as the buccal and terminal segments in the Maldaniea are never furnished with setæ. Moreover it is to be remarked that, in the *Petaloproctus* from St. Vaast, the cushions for the uncini of the seventeenth and five following segments extend even upon the back, where they close like a ring, and that this dorsal part of the segment is produced backward into a broad, thick point. The caudal extremity of *Clymene spathulata* so exactly corresponds with this description, that it probably

belonged to the same *Petaloproctus*. Perhaps *Rhodine Loveni*, Malmgr., also belongs here.

Malmgren follows the Maldaniea with the Ammocharidea as a distinct family, founded upon the genus *Ammochares*. He also describes a second genus, *Myriochele*, which seems almost to coincide with *Psammocollus*, Gr., but gives no character of the family, at least in his most recent work ('Annulata polychæta Spitzbergiæ' &c.). Kinberg, who establishes the same family, finds its character in the tentaculiform branchiæ seated on the buccal segment, in a change of bristles, and in the presence of superior setæ, and very numerous and minute uncini placed below them. The author would indicate (at the same time bringing together *Ammochares* and *Psammocollus*) that the body consists of only a few segments, increasing considerably in length towards the middle, that these are all furnished with setæ, and, with the exception of the foremost and hindmost, also with uncini (which, however, are placed in more than double and irregular rows, and not upon cushions), and that the buccal and terminal segments bear no plates, although the buccal segment may be produced in front into a lobe (cephalic lobe?) slit up into branches at the anterior margin. Their similarity to the Maldaniea, already treated of, strikes one at once; but with this conception of the character, Kinberg's genus *Sandanis*, as to the position of which he seems to be still doubtful, cannot be added to them; it should not be separated from *Capitella*.

To *Ammochares* belong 4 species:—*A. ottonis*, Gr., *A. assimilis*, Sars, *A. tegula*, Kinb., and *A. Sundevalli*, Kinb., the last known only by its anterior part.

Of *Psammocollus* we know only one species, *P. australis*, Gr., from the island of St. Paul; and of *Myriochele* likewise only one, *Myriochele Heeri*, Malmgr., which has been observed, but not abundantly, at Spitzbergen and Greenland.

XLIX.—*Description of* Fairbankia bombayana, *a new Genus and Species of* Rissoidæ *from Western India*. By William T. Blanford, A.R.S.M., F.G.S., C.M.Z.S.

The shell described below is one of the numerous peculiar estuarine forms so common on the shores of tropical seas. I have found but few specimens myself, and am indebted for a much larger number to the Rev. S. Fairbank and Dr. Leith. The latter very kindly procured me some living specimens about five years since. I had for a long time supposed the species to be a *Rissoa*; but two years ago I had occasion to

examine it more closely in connexion with the estuarine Rissoid genus *Iravadia*, and I then found that the present form showed distinctions not only from *Rissoa* proper, but also from all the other genera of Rissoidæ previously described.

FAIRBANKIA, nov. gen.

Animal tentaculis longis filiformibus; oculis ad basin tentaculorum sessilibus; proboscide elongata; pede antice lato, sinuato, postice rotundato.

Testa imperforata, turrita, epidermide fusca induta; apertura subovali, antice rotundata; peristomate leviter dilatato, margine externo acuto, sed extus variciformi-incrassato. *Operculum* corneum, subovale, subannulare; nucleo excentrico, juxta medium lateris columellaris posito, intus costa elongata verticali munitum.

This genus combines the epidermis and, to a great extent, the animal of *Hydrobia* with the peristome of a *Rissoa*, while the operculum differs from that of any other of the Rissoidæ, and approaches that of *Rissoella*.

From *Rissoa* the present genus is distinguished by its thick epidermis, straight smooth columella, and by the characters of the operculum,—from *Barleeia*, to which Dr. Stoliczka (Palæontologia Indica, v. p. 274) considers it very nearly allied, by its epidermis, its externally thickened peristome, by its operculum being horny and devoid of any long pointed apophysis (both genera have an internal raised rib), and by several distinctions in the form of the animal, such as the possession of long filiform tentacles, whilst those of *Barleeia* are described as short, broad, and rounded at the tips. From *Hydrobia* the operculum and thickened peristome amply distinguish the present genus.

On the whole, I am myself strongly disposed to believe that the most closely allied genus is that which I described recently as *Iravadia* (Journ. As. Soc. Bengal for 1867, vol. xxxvi. pt. 2. p. 56), from the estuary of the Irawady River. The operculum and animal of that genus are unknown: the shell possesses an epidermis, and has an external varix to the peristome; but the whorls are deeply sulcated, and the aperture is effuse in front, showing some approximation in form to that of *Rissoina*.

Fairbankia bombayana, n. sp.

Testa imperforata, non rimata, turrita, solidula, albida, lineis confertis spiralibus striisque incrementi minute decussata, epidermide fusco-olivacea induta. Spira lateribus convexiusculis, apice papillari, interdum erosulo, sutura impressa. Anfr. 7, convexi, ultimus subtus rotundatus. Apertura subovata, postice angulata; peristomatis marginibus conjunctis, externo mediocriter expanso.

varice externo forti. Operculum normale; costa interna ad ambas extremitates torta.
Long. 7, diam. vix 3 mill.; ap. $2\frac{1}{2}$ mill. longa, $1\frac{2}{3}$ lata.
Habitat Bombay.

Some specimens are smaller than the above: one with only five whorls remaining (one, at least, having been lost by erosion) measures only 5 millimetres in length by 2 in diameter.

The specimens found by myself were living on mud between tide-marks on the shore of Bombay Harbour. I believe Dr. Leith's and Mr. Fairbank's specimens were from the same locality. The principal Mollusca associated with them were species of *Assiminea*, *Haminea*, and *Ampullarina*.

L.—*On* Elachista stellaris, *a Seaweed new to the British Flora*. By Dr. J. E. Gray, F.R.S., V.P.Z.S., &c.

Mrs. Alfred Gatty has submitted to my examination some specimens, and some very accurate pen-and-ink sketches, of a species of *Elachista* which she regards as different from any that has hitherto been described as inhabiting the English coast. Mrs. A. Gatty discovered it growing on *Arthrocladia* on the Cardigan-Bay side of the Carnarvonshire promontory, at Pwllheli, and four miles further west at Llandwrog.

At first I thought that it might be the long-sought-for *E. curta* of Dillwyn in a more perfect condition, a plant that has not been recognized on the English coast for the last fifty years. On careful comparison with the description in Agardh's 'Species, Genera et Ordines Algarum' (vol. i. p. 9) there was no doubt that it is the *Elachista stellaris* of Areschoug's 'Dried Scandinavian Algæ' (part 3. no. 71), described in his paper in the 'Linnæa,' xvi. p. 233.

Elachista stellaris is known from all the other species of the genus by the filaments being nearly simple, radiating from a small, dense, hemispherical tubercle; the threads are rather narrowed below, and very much attenuated and produced into a long slender tip above; the joints of the lower part of the thread are as wide as long, and of the upper part two or three times as long as wide; the spore is oval, shortly pedicelled.

Dillwyn, in his 'British Confervæ,' described and figured a species under the name of *Conferva curta* (t. 76), which he says is not uncommon at Swansea. Knowing that Mrs. Story Maskelyne had the whole or part of her grandfather's collection, I wrote to her, requesting that I might be allowed to examine one of Mr. Dillwyn's original specimens; but, unfortunately, the part of the collection that she possesses does not

contain a specimen of *Conferva curta*, and I am not able to compare Mrs. Gatty's specimen with Mr. Dillwyn's.

In the 'English Botany' a plant is figured under the name of *Conferva curta* (t. 2034), which was drawn from a specimen communicated to Mr. Dawson Turner by Miss Hill, who found it growing parasitically on *Fuci* in the sea near Plymouth. Dr. Harvey figured *Elachista curta* in the 'Phycologia Britannica' (t. 332), from a poor specimen in the herbarium of Sir W. Hooker at Kew, observing that no one has met with it of late years. This specimen is most likely the one that Miss Hill gave to Dawson Turner, and it appears to be the only one now within the reach of the student. Unfortunately I am precluded by my health from going to Kew to examine it. The figures of Dillwyn and Harvey are very much alike, while that of the 'English Botany' is so indifferent that one would be by no means certain that it is intended for an *Elachista*, if we had not reason to believe the specimen from which the figure was taken is the same as that figured by Dr. Harvey. Dillwyn's and Harvey's figures induce me to believe that it is different from the species discovered by Mrs. Gatty, as they both represent the ends of the fibres as rounded, and not truncated and torn, as they would have been if it represented a worn specimen of *E. stellaris*. Agardh refers *E. curta* of Dillwyn (t. 76), with doubt, and *E. breviarticulata* of Suhr, as synonyms to the *Elachista globulosa* of the 'Species, Genera et Ordines Algarum' (i. p. 11). Areschoug gives the name of *E. curta* to the *Elachista flaccida* of Harvey. So there is no little confusion about the name of the species of this genus; and I fear the *E. curta* of Dillwyn is still to be sought for.

The British species may be divided into three very natural groups.

I. The filaments crowded together into a hard, compact cushion, repeatedly forked below, a long filament arising from the end of one and the spore at the tip of another branchlet. *Elachista*, Kützing.

E. scutulata, Harvey, Ph. Brit. t. 323.

II. The filaments divergent from below, forming a radiating tuft. The filaments repeatedly furcately branched below, one branchlet ending in a long filament, and the others tipped with a tuft of filaments having the spores at their base. *Phycophila*, Kützing.

E. fucicola, Harvey, Ph. Brit. t. 240. The branched basal fibres long, with long joints.

E. flaccida, Harvey, Ph. Brit. t. 260. The branched basal fibres short, with short joints.
E. curta, Harvey, Ph. Brit. t. 332.
?*E. stellulata*, Harvey, Ph. Brit. t. 261.

III. The filaments simple, diverging from each other and forming a tuft above, crowded together and forming a dense mass beneath. Spores on a short peduncle at the base of the filament. *Myriactis*, Kützing.

E. attenuata, Harvey, Ph. Brit. t. 28 A.
E. velutina, Harvey, Ph. Brit. t. 28 B.
E. stellaris, Areschoug.

LI.—*Notice of several Species of Spiders supposed to be new or little known to Arachnologists.* By John Blackwall, F.L.S.

Tribe **Octonoculina**.

Family Mygalidæ.

Genus Filistata, Walck.

Filistata depressa.

Teratodes depressus, Koch, Die Arachn. Band ix. p. 103, tab. 324. fig. 755.

An adult male of this remarkable species was captured in the Island of Bermuda.

Family Lycosidæ.

Genus Sphasus, Walck.

Sphasus ornatus.

Sphasus pulchellus, Blackw. Ann. & Mag. Nat. Hist. ser. 3. vol. xviii. p. 452.

Perceiving that the specific name *pulchellus*, originally given by me to this spider, had been previously conferred on another species of the same genus by M. Lucas (Archives Entomologiques, tome ii. p. 387), I here substitute for it that of *ornatus*.

Family Salticidæ.

Genus Salticus, Latr.

Salticus diversus, n. sp.

Length of the male $\frac{5}{16}$ of an inch; length of the cephalothorax $\frac{3}{16}$, breadth $\frac{1}{8}$; breadth of the abdomen $\frac{1}{16}$; length of a posterior leg $\frac{2}{5}$; length of a leg of the second pair $\frac{1}{3}$.

The minute intermediate eye of each lateral row is nearly

equidistant from the eyes constituting its extremities. The cephalothorax is large, convex, glossy, and somewhat quadrilateral; it slopes to each extremity, projects a little beyond the falces in front, and has a broad shallow indentation between the posterior pair of eyes; its prevailing colour is black; a broad red-brown band passes from the posterior pair of eyes to its base, and another band of the same hue extends along each side, a little above the lateral margin; these bands are densely covered with white hairs; in the cephalic region there are some pale-grey hairs constituting a continuation of the medial band; a few red hairs occur above the anterior eyes, and some long ones of a pale-yellow hue project from its anterior margin. The falces are subconical and vertical; the maxillæ are straight, and enlarged and rounded at the extremity; and the lip is oval. These parts are of a dark-brown colour; the apex of the lip and the extremity of the maxillæ are tinged with red, the latter being much the palest. The sternum is oval, provided with long hairs, and has a yellowish-brown hue. The legs are robust, especially those of the first and second pairs, and are provided with long hairs and sessile spines; they are of a yellowish-brown colour, the tarsi being the palest, and have dark-brown spots and longitudinal streaks on the sides and upper part, those on the femora being the most conspicuous; the anterior pair are much the darkest-coloured, the genual joint, tibiæ, and metatarsi being of a dark-brown hue, and the tarsi having a tinge of red; the fourth pair is the longest, then the first, which a little surpasses the third, and the second pair is the shortest; each tarsus is terminated by two curved, pectinated claws, and below them there is a small scopula. The palpi are short, well supplied with hairs, and of a dull-yellowish hue, the base of the humeral joint having a tinge of brown; the radial joint projects a pointed apophysis from its extremity, on the outer side; the digital joint is oval, convex and hairy externally, concave within, comprising the palpal organs, which are well developed, prominent and convex at the base, and have a fine pointed spine curved from the inner side round their extremity to the outer side; their colour is a mixture of dark and pale reddish brown. The abdomen is oviform, somewhat depressed, rather pointed towards the spinners (which are prominent), well clothed with hairs, and projects a little over the base of the cephalothorax; the upper part has a black hue; a white band, whose posterior half is the broadest, extends along the middle, from which a short white ray projects on each side at about a third of its length from the spinners; the sides are white, with soot-coloured streaks and spots; and the under part

is of a yellowish-grey hue with some reddish hairs intermixed, and has three brown bands in the middle, which unite in a point near the spinners.

An adult and an immature male of this *Salticus* were taken in the Island of Bermuda.

Family Thomisidæ.

Genus Thomisus, Walck.

Thomisus pallens, n. sp.

Length of an immature female $\frac{5}{24}$ of an inch; length of the cephalothorax $\frac{1}{10}$, breadth $\frac{1}{10}$; breadth of the abdomen $\frac{1}{12}$; length of an anterior leg $\frac{2}{5}$; length of a leg of the third pair $\frac{1}{6}$.

The cephalothorax is slightly compressed before, truncated in front, rounded on the sides, depressed at the base, convex, and glossy; the falces are subconical and vertical; the maxillæ are convex near the base, obliquely truncated at the extremity, on the outer side, and inclined towards the lip, which is triangular; the sternum is heart-shaped; the legs are glossy, sparingly supplied with hairs, and have two parallel rows of spines on the inferior surface of the tibiæ and metatarsi of the first and second pairs, which are much longer than the third and fourth pairs; the first pair slightly surpasses the second, and the third pair is the shortest; each tarsus is terminated by two curved, pectinated claws; the palpi are short, and have a small, curved, pectinated claw at their extremity. These parts have a pale dull-yellowish hue, the lateral margins of the cephalothorax being the palest. The eyes, which are dark-coloured, are disposed on the anterior part of the cephalothorax in two transverse curved rows, forming a crescent whose convexity is directed forwards; the four intermediate ones describe a square; and the eyes of each lateral pair are seated obliquely on a conspicuous pale tubercle, the anterior one being the largest of the eight. The abdomen is oviform, somewhat depressed, thinly clothed with short hairs, and projects over the base of the cephalothorax; on the anterior half of the upper part there are five depressed spots, which describe a narrow, elongated angle whose vertex is directed forwards; its colour is yellowish-white, the upper part being the palest.

An immature female of this spider was captured in the Island of Bermuda.

Thomisus Gloveri, n. sp.

Length of the female $\frac{5}{24}$ of an inch; length of the cephalothorax $\frac{1}{10}$, breadth $\frac{1}{10}$; breadth of the abdomen $\frac{1}{8}$; length of

a leg of the second pair $\frac{3}{10}$; length of a leg of the third pair $\frac{1}{5}$.

The eyes are disposed on the anterior part of the cephalothorax in two transverse, curved rows, forming a crescent whose convexity is directed forwards; the four intermediate ones describe a square; and the eyes of each lateral pair are seated obliquely on a whitish tubercle, the anterior one being the largest of the eight. The cephalothorax is compressed before, truncated in front, rounded on the sides, depressed at the base, convex, with a few bristles on the anterior part, and a row directed forwards from the frontal margin, which projects a small oval process between the bases of the falces; the sides are of a dark-brown colour passing into black at their posterior part, which is glossy; and a broad, obscure, reddish-brown band extends from the eyes to the bifid extremity of a short band at the base, which, with the lateral margins, is white. The falces are short, strong, cuneiform, vertical, red-brown at the base, with a few bristles towards the inner side, white near the middle and black at the extremity. The maxillæ are convex near the base, pointed at the extremity, and inclined towards the lip, which is triangular. The colour of these parts is dark-brown at the base, and pale reddish-brown at the extremity. The sternum is heart-shaped, and has a few bristles on each side of its anterior part; it is of a dark-brown hue obscurely freckled with yellowish-grey, the lateral margins being the darkest. The legs are provided with hairs and spines, two parallel rows of the latter occurring on the inferior surface of the tibiæ and metatarsi of the first and second pairs, which are much longer and more robust than the third and fourth pairs; the second pair slightly surpasses the first, and the third pair is the shortest; each tarsus is terminated by two curved, pectinated claws; the predominant colour of the first and second pairs of these limbs is dark-brown, the anterior side and the inferior surface of the femora having a greyish hue, and the extremity of the joints a yellowish-white or reddish-white tint; the third and fourth pairs are of a yellowish-white colour, and are marked with dark-brown spots and annuli; all the tarsi have a reddish-brown hue. The palpi are short, and have a curved, pectinated claw at their extremity; they are of a yellowish-white colour, tinged with red and spotted with brown, the digital joint having a reddish-brown hue. The abdomen is somewhat oviform, moderately convex above, broader at the posterior than at the anterior extremity, corrugated on the sides and sparingly clothed with short dark-coloured hairs; the upper part, which is of a dark dull-red colour, has five circular depressions on its anterior

half, forming an acute angle whose vertex is directed forwards; a whitish streak passes from the depression at the vertex of the angle a little beyond its base; and the whole is encircled by an irregular zone of the same hue, which has several transverse black bars on each side of its posterior half; there are two black streaks on the posterior part, which meet in an angle at the coccyx; the sides and under part are of a brownish-black colour; the former are the darker, and the latter is indistinctly freckled with yellowish-grey; the sexual organs are rather prominent, nearly circular, and of a red-brown hue, the margin being much the darkest; and the colour of the branchial opercula is brown, that of their inner margin being yellowish-white.

This *Thomisus*, which was found on a rail at Hendre House in September 1868, I dedicate to that excellent naturalist Thomas Glover, Esq., of Smedley House, near Manchester, who on various occasions has transmitted to me specimens of rare British spiders.

Genus Olios, Walck.

Olios antillianus.

Olios antillianus, Walck. Hist. Nat. des Insect. Apt. tom. i. p. 568.

Several adult males of an *Olios*, which appear to be specifically identical with the spider described under the above name by Walckenaer, were taken in the Island of Bermuda.

Family Drassidæ.

Genus Drassus, Walck.

Drassus Bewickii.

Drassus Bewickii, Blackw. Ann. & Mag. Nat. Hist. ser. 3. vol. xiv. p. 176.

Length of the male (not including the spinners) $\frac{3}{8}$ of an inch; length of the cephalothorax $\frac{1}{5}$, breadth $\frac{3}{20}$; breadth of the abdomen $\frac{1}{8}$; length of a posterior leg $\frac{7}{12}$; length of a leg of the second pair $\frac{9}{20}$.

The abdomen is of an oblong-oviform figure, somewhat convex above, and projects very little over the base of the cephalothorax; it is glossy, sparingly clothed with hairs, and of a pale-brown colour; at the anterior extremity, contiguous to the cephalothorax, there is a transverse, curved, dark-coloured mark, thickly covered with long black hairs, whose convexity is directed upwards; and a longitudinal soot-coloured band, which is bifid at its extremity, extends nearly half the length of the upper part; to this band a series of rather obscure, soot-coloured angular lines succeeds, which diminish in

extent as they approach the spinners; their vertices are directed forwards, and their extremities are enlarged; the sides are marked with oblique streaks of the same hue, the anterior one being the broadest; and there are a few small soot-coloured spots on the under part; the spinners are long, especially those of the superior pair, which are triarticulate, with the spinning-tubes situated on the extremity of the short terminal joint; these organs are cylindrical, very prominent, and of a yellowish-brown hue tinged with red, the inferior pair being the strongest and much the darkest-coloured. The eyes are disposed on the anterior part of the cephalothorax in two transverse rows; the two intermediate ones of the posterior row, which is almost straight, are nearer to each other than they are to the lateral eyes of the same row, which are the smallest; the anterior row is the shorter, and is curved, having its convexity directed upwards; the two intermediate eyes are the largest and darkest-coloured of the eight, and the lateral eyes of the two rows are separated by a wide interval. The cephalothorax is large, convex, depressed towards each extremity, glossy, thinly clothed with hairs, compressed before, and rounded on the sides, which are marked with slight furrows converging towards a narrow indentation in the medial line of the posterior region; it is of a reddish-brown colour, with narrow dark-brown lateral margins. The falces are powerful, conical, nearly vertical, and have a red-brown hue. The maxillæ are convex at the base, rounded at the extremity, near which there is an oblique transverse furrow, and are strongly curved towards the lip, which is long and rounded at the apex; and the sternum is oval. These parts have a yellowish-brown hue, the lip, which is the darkest, having a tinge of red. The legs are moderately robust, provided with hairs and sessile spines, and have a yellowish-brown hue; the fourth pair is the longest, then the first, and the third pair slightly surpasses the second; each tarsus is terminated by two curved, pectinated claws, and has hair-like papillæ on its inferior surface. The palpi resemble the legs in colour; and the radial, which is rather shorter than the cubital joint, projects a small obtuse protuberance from its extremity, on the underside, and a red-brown pointed apophysis in front, towards the outer side; the digital joint is oval, convex and hairy externally, concave within, comprising the palpal organs, which are well developed, with a long curved spine on the inner side, whose pointed extremity extends beyond the concavity, and a crescent-shaped process towards the outer side, whose longer limb is recurved at its extremity; their colour is dark reddish-brown mixed with yellowish-brown.

Adult and immature males of this singular *Drassus* were captured in the Island of Teneriffe.

Genus Clotho, Walck.

Clotho Paivani, n. sp.

Length of the female (not including the spinners) $\frac{3}{8}$ of an inch; length of the cephalothorax $\frac{3}{20}$, breadth $\frac{3}{20}$; breadth of the abdomen $\frac{1}{5}$; length of an anterior leg $\frac{1}{2\,4}$; length of a leg of the third pair $\frac{5}{1\,2}$.

The cephalothorax is reniform, convex, glossy, with a large indentation in the medial line, and is of a dark-brown colour, the margins being rather the palest. The eyes are disposed on the anterior part of the cephalothorax, high above the frontal margin; three on each side describe a curve whose convexity is directed outwards, the posterior one being the smallest, and two, situated transversely between the curves, are much the largest of the eight. The falces are slender, subconical, and vertical; the maxillæ are very convex near the base, depressed, oval, and somewhat pointed at the extremity, and greatly inclined towards the lip, which is triangular and pointed at the apex; the sternum is flat and reniform. These parts are of a dark-brown hue, the extremity of the falces and the apex of the lip, which are the palest, having a tinge of red. The legs are strong, hairy, nearly equal in length, the third pair being slightly the shortest, and are somewhat paler than the cephalothorax; each tarsus is terminated by three claws; the two superior ones are curved and minutely pectinated, and the inferior one is inflected near its base. The palpi, which are robust and hairy, resemble the legs in colour; they mask the falces, and have a curved claw at their extremity. The abdomen is oviform, glossy, sparingly clothed with short hairs, and projects over the base of the cephalothorax; it is of a dull-brown colour, the under part being the palest, and has an obscure yellowish-white oval zone on the upper part, whose inner margin projects a point on each side into the intermediate brown space, near its middle; the superior spinners are triarticulate, and have the spinning-tubes distributed on the inferior surface of their long terminal joint; they are directed upwards, and are curved towards the anus, which is oval and is encompassed by a dense fringe of long hairs, except at its posterior extremity: the sexual organs are nearly circular, and have a reddish-brown hue.

The male is smaller than the female, and the colour of its cephalothorax, falces, maxillæ, lip, sternum, legs, and palpi is yellowish-brown. The abdomen is of a dark-brown hue

tinged with olive where that of the female is dull brown; and the yellowish-white oval zone on the upper part is much more distinctly marked. The cubital and radial joints of the palpi are short; the digital joint has a short oval form; it is convex and hairy externally, concave within, comprising the palpal organs, which are highly developed, complex in structure, with a large and somewhat crescent-shaped piece at their extremity, which has a pale-yellowish hue; between the horns of the crescent, the outer one of which is the longer and more pointed, a large, curved, brown, prominent process projects, which is directed backwards; it extends to the base of the humeral joint, is hollowed at its extremity, on the under side, has a strong, brown, pointed process at its base, on the inner side, and a long, slender, upright one, of a pale hue tinged with red, towards the outer side.

I have included this spider, provisionally, in the family Drassidæ; but it presents such a singular combination of characters that it is difficult to determine precisely the place it should occupy in a systematic arrangement of the Araneidea.

In connecting the name of the Barão do Castello de Paiva with this *Clotho* (numerous specimens of which, both males and females in various stages of growth, were taken in the Island of Teneriffe), I avail myself of the opportunity to express my sense of the obligation I am under to him for the many interesting species of spiders with which he has favoured me.

Family Epeïridæ.

Genus Epeïra, Walck.

Epeïra gracilipes.

Epeïra gracilipes, Blackw. Ann. & Mag. Nat. Hist. ser. 3. vol. x. p. 437.

An adult male of this species was captured in the Island of Bermuda.

Tribe **Senoculina.**

Family Scytodidæ.

Genus Scytodes, Latr.

Scytodes pallida.

Scytodes pallida, Blackw. Ann. & Mag. Nat. Hist. ser. 3. vol. xvi. p. 100.

An immature female of *Scytodes pallida* was taken in the Island of Bermuda.

For the spiders from the Island of Bermuda I am indebted to the kindness of Captain Francis Lyon, of the Royal Artillery, and for those from the Island of Teneriffe to the Barão do Castello de Paiva.

LII.—*On Crustacea Amphipoda new to Science or to Britain.*

By the Rev. Alfred Merle Norman, M.A.

[Plates XXI., XXII., and XXIII. figs. 1–11.]

Genus Haploops, Lilljeborg.

Body compressed, coxæ deep. *Eyes* two, simple. *Superior antennæ* slender, no secondary appendage. *Mandibles* with a three-jointed, *maxillæ* with two-jointed, and *maxillipedes* with four-jointed palp. Both *gnathopods* having a small subchelate hand. First and second *pereiopods* with the metacarpus dilated, the wrist and hand narrower, the nail long and straight. *Pleon* having the fifth and sixth segments coalesced. Last *uropods* two-branched, branches flattened.

Haploops tubicola, Lilljeborg. Pl. XXI. figs. 1–3.

Ampelisca Eschrichtii, Lilljeborg, Öfvers. af Kongl. Vet. Akad. Förhandl. 1852, p. 6.

Haploops tubicola, Lilljeborg, Öfvers. af Kongl. Vet. Akad. Förhandl. 1855, p. 134; Bruzelius, Skand. Amphip. Gammaridea (1859), p. 88; Bate, Cat. Amphip. Crust. Brit. Mus. p. 371; Norman, Trans. Tyneside Nat. Field Club, vol. v. (1863) p. 279; Göes, Crust. Amphip. maris Spetsbergiam alluentis (1865), p. 12.

Superior antennæ shorter than inferior; middle joint of peduncle the longest. *Inferior antennæ* having the peduncle rather longer than that of superior, last joint slightly longer than fourth; flagella of both antennæ fringed throughout with unusually long and conspicuous setæ. *Gnathopods*: both pair alike, hairy; hand ovate, rather shorter than wrist; finger small. *First* and *second pereiopods* with metacarpus very long and flattened, longer than wrist and hand combined; wrist very short, hand double length of wrist; nail very long, slender, and acute. *Third* and *fourth pereiopods* presenting an unusual appearance, from the wrist being much broader at its termination than the hand, which articulates with the anterior portion of its distal extremity, while the posterior portion is furnished with a bundle of stout spines; there are also three transverse rows of spines on the sides of the wrist; hand as long as wrist, but only half as broad; nail very short, stout. *Last pereiopods* with the thigh produced posteally and also inferiorly, but in such a way that the hinder margin is slightly concave; surface of thigh setose; metacarpus and wrist expanded, wide, flat, lobed at the margins and edged with spines and spine-like setæ; hand and nail very minute, combined scarcely larger than an ordinary nail; hand articulating with

the wide extremity of the wrist, in a central hollow between two lobes. *Pleon* usually (but not invariably) having a hump on the back of the fourth segment. *Telson* squamiform, semi-elliptic, cleft almost to the base, cleft narrow, not widening at the extremity. *Uropods*: first scarcely equalling second; last having two flattened, one-jointed, equal rami; inner margin of inner ramus with three short blunt spines, its extremity and both margins of exterior ramus setose. *Length* $\frac{4}{10}$ inch.

Göes remarks on this species:—"Ex abysso ad Aukpad-lartok Grœnlandiæ copiam magnam retulit Torell speciminum valde robustorum et oculis quatuor, duobus in vertice, duobus in angulo infero-laterali antico capitis insignium—ceterum cum nostra plane congruentium." My Northumberland specimens agree with those from Greenland in having *four* simple eyes. The number of eyes, therefore, would not seem to be constant; but there are ample grounds for separating the genus *Haploops* from *Ampelisca*.

First found by me in deep water off Berwick, and seven miles off Tynemouth, Northumberland, in 1862, and again dredged in 1866 in the Minch.

Genus Tessarops, n. g.

Eyes four—two (large, compound) situated above the origin of the superior antennæ, and two (nearly simple) below the others, at the base of the superior antennæ. *Superior antennæ* furnished with a very slender secondary appendage. Both pair of *gnathopods* simple, not subchelate. Last *pereiopods* short, stout. *Pleon* having dorsal margins of segments toothed. *Telson* squamiform. Last *uropods* two-branched.

Tessarops hastata, n. sp. Pl. XXII. figs. 4–7.

? *Tiron acanthurus*, Lilljeborg, Amphipoda Lysianassina, 1865, p. 19.
? *Syrrhoë bicuspis*, Göes, Crust. Amphip. maris Spetsbergiam alluentis, 1865, p. 12, pl. 40. figs. 26 *a–l*.

Head produced. Upper *eyes* ovate, large; lower eyes (in type specimen) consisting of two lenses. *Superior antennæ* having each joint of the peduncle shorter than the preceding one; flagellum composed of ten, secondary appendage of five very long articulations; the basal articulation of the flagellum longer than either of the last two joints of the peduncle; the secondary appendage is remarkably slender at the base, and equals the first four articulations of the flagellum in length. *Inferior antennæ* considerably longer than the superior; last joint of peduncle equal to two-thirds the length of the penultimate, flagellum of about the same length as the peduncle.

The antennæ present a very unusual appearance, from their peculiar nakedness and smooth rounded contour; there is not a single spine upon any part, and the peduncles have but very few, minute, scarcely noticeable cilia. *First gnathopods* having the wrist long and slender, gradually (but only slightly) tapering from the base to the distal extremity; hand very narrow, not subchelate, no palm; finger half as long as hand, nearly straight, with a spine on the inner margin at half its length; posterior margin of wrist and hand setose. *Second gnathopods* almost exactly like the first; but the margin of wrist and hand is more sparingly setose, and the whole form rather more slender. Last *pereiopods* short and stout; thigh much expanded posteally; both wrist and hand shorter than the preceding joint (metacarpus); nail strong, short, very thick at the base. *Pleon* having distal margins of first three segments serrate (teeth about ten); fourth, fifth, and sixth segments produced posteally into a single spear-like process, that of the fifth segment of immense size. *Telson* squamiform, of great size, equalling the three preceding segments in length. First *uropods* longer than the second, and reaching to the middle of the rami of the last; last uropods slightly extending beyond the telson, consisting of a short flattened peduncle and two flattened blades of equal length. *Length* a little more than a fourth of an inch. *Colour* reddish; antennæ banded with brown; eyes blood-red.

This is a very remarkable genus, on account of the character of the eyes, the peculiar naked appearance of the antennæ, and the structure of the pleon and its appendages.

The type specimen was sent to me by Mr. Dawson, who dredged it, in 1865, off the Aberdeenshire coast.

My only specimen is mounted for the microscope, and I am prevented obtaining a dorsal view of the telson, which may or may not be cleft.

Nicippe, Bruzelius.

Body rather stout; coxæ moderately deep. *Antennæ* slender, the upper with secondary appendage. *Mandibles* dissimilar, furnished with three-jointed palps—the one having an accessory process or internal branch, the other without it. Palp of first *maxillæ* two-jointed. *Maxillipedes* having the laminæ small, and the palp four-jointed. Both pair of *gnathopods* subchelate. Last three pairs of *pereiopods* gradually increasing in length. Last *uropods* two-branched, both branches composed of one joint only.

Nicippe tumida, Bruzelius. Pl. XXI. figs. 4–6.

Nicippe tumida, Bruzelius, Skandinaviens Amphipoda Gammaridea (1859), p. 99, pl. 4. fig. 19; Bate, Cat. Amphip. British Museum, p. 374.

Superior antennæ with very short peduncle, not longer than the head, first two joints subequal, last joint not half the length of the preceding; flagellum long and slender, first joint long, following joints wider than long; appendage five-jointed. *Inferior antennæ* much shorter than the superior, but the peduncle considerably longer. *Gnathopods* of similar structure; wrist short, triangular; hand regularly ovate, palm undefined, finger slender, only very slightly curved, as long as the hand. *Pereiopods* with peculiarly long, perfectly simple, straight nails; last pair long and slender, thigh narrow, furnished with a most remarkable appendage on the middle of the posterior margin (which is not expanded); this appendage consists of a very long styliform process, the distal portion of which is a plume formed of hairs springing from all sides of the axis. *Pleon* with two small teeth on the posterior dorsal margin of the fourth segment. *Telson* squamiform, divided almost to the base, and consisting of two long, narrow, diverging portions, furnished with three or four lateral and two terminal long slender spines. *Uropods*: first pair rather longer than second, both margined with numerous very long slender spines; last pair having on the basal portion a tuft of long slender spines; rami subequal, long, narrowly lanceolate, fringed with very long plumose setæ. *Length* not quite half an inch.

Two specimens, taken by Mr. Jeffreys and myself, in July 1866, in the Sound of Skye. Mr. Bate, in his 'Catalogue of the Amphipodous Crustacea in the British Museum' (p. 374), states that he had seen a specimen from Shetland; but possibly there may have been some mistake in this, as the species is not included in the 'British Sessile-eyed Crustacea.'

The short peduncle of the upper antennæ, the ovate gnathopods, and, above all, the extraordinary styliform appendage of the thigh of the last pereiopods at once suffice to distinguish this species. What the use of the last-mentioned organ is I can form no idea; the nearest approach to it in structure that I know among the Crustacea is to be found in the abdominal setæ of the Cladocera.

Genus Eriopis, Bruzelius.

Body elongated, slightly compressed; coxæ small. *Superior antennæ* with a slender peduncle and a very minute secondary appendage. *Inferior antennæ* subpediform. *Mandibles* two-

branched, with a molar tubercle and a three-jointed palp. *First maxillæ* having a two-jointed, and *maxillipedes* a four-jointed palp. *Gnathopods* with subchelate hands. Last three *pereiopods* gradually increasing in length. Last *uropods* two-branched, branches very unequal, the inner short, the outer nearly as long as the whole pleon, composed of two flattened joints.

Eriopis elongata, Bruzelius. Pl. XXI. figs. 7–10.

Eriopis elongata, Bruzelius, Skandinaviens Amphipoda Gammaridea (1859), p. 65, pl. 3. fig. 12; Bate, Cat. Amphip. Crust. Brit. Mus. p. 178, pl. 32. fig. 5.

Superior antennæ of immense length; peduncle long and slender, first two joints subequal, a spine at the distal extremity of the first, third short; flagellum of extraordinary length; secondary appendage very minute, and only to be seen when carefully looked for, consisting of two joints, closely appressed to the first joint of the flagellum. *Inferior antennæ* about equal in length to the peduncle of the superior; flagellum six-jointed and shorter than the last joint of the peduncle. *First gnathopods* smaller than the second; hand triangular, greatly widening from the base to the palm, which is scarcely at all oblique and slightly convex; finger simple, nearly straight. *Second gnathopods* with an ovate hand, twice as long as the wrist, palm continuous with the posterior margin, and two-thirds the length of the hand, armed with four spines; finger long, simple, gently curved, with about ten little cilia on the inner margin. *Last pereiopods* having the posterior margin of the thigh deeply serrate, and a small cilium springing from each serration. *Telson* squamiform, divided almost to the base, each portion terminating in two spines. *Uropods*: first pair rather longer than the second; last pair monstrously developed, consisting of a basal joint and two branches—one branch shorter than the basal joint, the other nearly equalling in length the whole pleon, and consisting of two linear flattened joints, the second slightly shorter than the first. *Length* $\frac{4}{10}$ inch.

A single specimen was taken by Mr. Jeffreys and myself in the Sound of Skye, in 1866. The very long superior antennæ and extraordinarily developed uropods give to this species a most remarkable appearance. My British specimen and a Bohuslän example, for which I am indebted to Prof. Lovén, both want the telson and posterior uropods: the description and figure, therefore, of these organs have been taken from Bruzelius, while the rest of the animal is described from the Skye specimen: this last had the uropods when dredged; but being put into a bottle of spirit with other Crustacea, they were unfortunately broken off and thus lost.

Mæra Lovéni, Bruzelius. Pl. XXI. figs. 11, 12.

Gammarus Lovéni, Bruzelius, Skandinaviens Amphipoda Gammaridea (1859), p. 59, pl. 1. fig. 9.
Mæra Lovéni, Bate, Cat. Amphip. Crust. Brit. Mus. p. 193, pl. 35. fig. 1.

Superior antennæ having the first two joints of the peduncle remarkably long, slender, and smooth, the second joint slightly longer than the first, third joint not one-third the length of the second; flagellum (about 17-jointed) not quite as long as the peduncle; secondary appendage 5-jointed, equal to four joints of flagellum in length. *Inferior antennæ* scarcely, if at all, longer than peduncle of superior antennæ, the peduncle having the last two joints subequal and long; flagellum of about seven joints. *First gnathopods* with wrist subtriangular, posteally furnished with numerous tufts of setæ, and having five transverse and three oblique rows of setæ on the side, the setæ of the oblique rows much smaller than those of the transverse rows; hand subovate, equal in length to the wrist, wider at the extremity than at the base; palm convex, scarcely defined, scattered setæ on both margins; finger strong, only slightly curved, simple, with a few setæ on the outer and about nine little cilia on the inner margin. *Second gnathopods* with a short triangular wrist, which is much wider at the extremity than the last, and has a few scattered setæ on the front, and numerous setæ on the hinder margin; hand large, twice as long as the wrist, subquadrate, widening distally, with a few setæ on each margin; palm slightly oblique, defined, a little convex, and serrated, serrations distant, six only on length of palm; finger strong, slightly curved, simple, with a few setæ on exterior and about nine minute cilia on inner margin. *First pereiopods* having the nail long (half as long as hand) and nearly straight.

The only evidence I as yet have of this species being British is the anterior half of the animal here described, which was dredged by Mr. Jeffreys and myself in the Sound of Skye, in 1866. It agrees so closely with Bruzelius's description and figures of *M. Lovéni* that there can, I think, be no question as to its identity with that species. I have very minutely described the parts of the animal obtained, that those who hereafter may meet with perfect specimens of *M. Lovéni* may be better able to decide whether the Skye fragment has rightly been referred to that species; but of this I do not entertain the slightest doubt, as it exactly agrees with Bruzelius's description and figures.

Mæra Batei, n. sp. Pl. XXII. figs. 1–3.

Superior antennæ having second joint of peduncle consider-

ably longer than the first; third joint short, not more than one-fourth the length of the second; flagellum about equal in length to peduncle (22–24 joints); appendage 4–5-jointed. *Inferior antennæ* short, about equal to peduncle of superior in length, last two joints of peduncle subequal; flagellum not longer than last joint of peduncle (about 8 articulations). *First gnathopods* slender; wrist and hand parallel-sided, of equal breadth throughout, both margins fringed with setæ; hand shorter than wrist; palm slightly oblique, finger slender. *Second gnathopods* in ♂ very large; wrist triangular, short; hand large, subquadrate, with an oblique palm extending one-third its length; palm furnished with three well-marked tubercles, the distal tubercle flat-topped (or cup-formed?), surmounted by a circlet of setæ; finger stout, very strongly curved, inner edge sparingly ciliated, closing with the palm between the first and second tubercles, arching over and leaving a space between its inner margin and the summit of the distal tubercle; second gnathopods in ♀ only slightly stronger than the first pair, and not differing greatly from them in structure; the hand, however, is ovate, the inferior margin gradually sloping upwards to the base of the finger, without having any defined palm; finger small, furnished with two spines near the end. *Last pereiopods* with the thigh (basos) narrow and nearly parallel-sided, the distal joints strongly spined, the claw strong and nearly straight. *Pleon* having the infero-posteal angles of second and third segments not serrate, but furnished with a single spine; dorsal margin of all the segments except the first toothed; second segment with three, third with five teeth; fourth, fifth, and sixth with two teeth, each tooth having a spine at the inner side of its base. *Uropods*: first pair much longer than the second, but scarcely longer than the peduncle of the last; last immensely developed, the peduncle long and very stout, the rami subequal, consisting of very long flattened blades, edged with and terminating in spines; the length of the entire uropod is nearly equal to that of the last six segments of the pleon taken together. *Length* (full-grown male) $\frac{3}{8}$ inch, exclusive of antennæ.

Dredged off St. Martin's Point, Guernsey, in 1864, by Mr. Jeffreys and myself.

I can see no sufficient characters by which to distinguish the genus *Megamæra* of Mr. Bate from *Mæra*; the depth of the coxæ is very variable in closely allied species.

It will be seen from the preceding description that the female differs very materially from the male in the size and structure of the second pair of gnathopods. This is universally the case in the genus; and from a want of knowledge of this fact

the two sexes have frequently been described as different species. The number of British forms must be considerably reduced. *Megamæra Othonis* is the female of *M. longimana*; and *Megamæra Alderi* is the female of *Melita obtusata*, with which species *Melita proxima* must also be united as another and the more usual form of the male.

I have named this species after my friend Mr. Spence Bate —a slight tribute to one who deserves much honour for his valuable labours in the investigation of the Sessile-eyed Crustacea.

HELLERIA, nov. gen.

Eyes compound. *Superior antennæ* slender, much shorter than inferior, with secondary appendage. Both *gnathopods* subchelate. Last *pereiopods* rather short, furnished with long plumose setæ. Fifth and sixth segments of *pleon* coalesced into one. Last *uropods* two-branched. *Telson* squamiform, cleft almost to the base.

This genus is easily distinguished by the peculiar structure of the hinder portion of the pleon, with its coalesced fifth and sixth segments. I have dedicated it to Prof. Heller, who has done so much to elucidate the Crustacea of the south of Europe.

Helleria coalita, n. sp.
Pl. XXII. fig. 8, and Pl. XXIII. figs. 1–6.

Eye round, situated between the origins of the upper and lower antennæ. *Superior antennæ* having first joint of peduncle of moderate dimensions, somewhat shorter than the second; third joint not longer than, and scarcely differing in appearance from, the first joint of the flagellum; the peduncle not furnished with any spines, having only a few very small cilia; flagellum consisting of about nine elongated articulations, and slightly exceeding the peduncle in length. *Inferior antennæ* very long, last and penultimate joints of peduncle subequal in length, the latter with the lower margin convex, the upper clothed with short down; flagellum slender, the joints remarkably long. *First gnathopods* with wrist and hand of about equal length, the latter subquadrate; palm scarcely oblique, well defined, a little convex; finger gently curved, shutting closely with the palm. *Second gnathopods* almost identical with the first in size and structure. *Last pereiopods* short; thigh expanded behind into a semielliptic lobe, which is widest above, and has a simple (*i. e.* not serrate) margin; metacarpus and wrist wide, and fringed on both margins with long plumose setæ, which project at right angles from the limb; hand narrow, styliform, equal to wrist in length; nail strong, bent at right angles to the hand. *Pleon* with coxæ of first

three segments deep, their infero-posteal angles completely rounded off. A marked line of separation between third and fourth segments; fourth, fifth, and sixth segments almost coalesced, the two latter actually so; the dorsal margin elevated into three little tuberculated humps, which mark the three segments; the sixth segment abruptly truncated behind, the telson being attached to the lower edge of the truncation. *Telson* squamiform, semielliptical, cleft almost to the base, cleft linear. First *uropods* much longer than second, and as long as the last (exclusive of their setæ), last having a broad peduncle and two widely lanceolate rami, which have their margins furnished with long plumose setæ. The structure of the shell of this species consists of hexagonal cells, which are extremely conspicuous and remarkably regular and elegant on the coxæ of the last pereiopods. *Length* scarcely a tenth of an inch.

This species has never been taken with the dredge: it is a capital swimmer, and is procured by means of the surface-net.

Shetland (A. M. N. and Mr. D. Robertson); Moray Firth (Mr. T. Edward); Firth of Clyde (Mr. D. Robertson).

The characters which will enable this species to be recognized at a glance are, first, the coalesced fifth and sixth segments of the pleon, and the remarkable posterior truncation of the latter; and, secondly, the form of the last pereiopods, and especially their elegant hexagon-celled thighs.

Microprotopus, Norman.

Superior antennæ furnished with a secondary appendage. *First gnathopods* subchelate. *Second gnathopods* subchelate, larger than the first, greatly developed in the male, but scarcely larger than the first in the female. *Uropods* terminating in simple spines, those of the last pair having only a single ramus. *Telson* tubular.

This genus is closely allied to *Microdeuteropus*. It differs from that genus inasmuch as the second gnathopods are larger than the first, the contrary being the case in *Microdeuteropus*—and in the last pair of caudal appendages, which have only one branch.

Microprotopus maculatus, Norman. Pl. XXIII. figs. 7–11.

Microprotopus maculatus, Norman, Report British Association, 1866 (1867), Reports, p. 203.

Male.—Eye small, round, crimson, situated on a projecting lobe between the bases of the two pairs of antennæ. *Antennæ* subequal in length; the peduncle of the *superior* reaches a little beyond the penultimate joint of the peduncle of the *in-*

ferior antennæ; the basal joint is thicker than the second, to which it is subequal in length; the third joint is shorter and more slender than either of the preceding; flagellum 9–10-jointed, of about the same length as the peduncle; the secondary appendage minute, two-jointed, not so long as the first joint of the flagellum. *Inferior antennæ* stronger than the superior; both pairs are furnished with scattered hairs, but no spines. The *mandible* is furnished with a three-jointed palp. The *first gnathopods* have the hand equal in length to the wrist, but broader, and widening from the base to the extremity; the palm is oblique and concave; the nail well developed, simple, and extending rather beyond the palm. The *second gnathopods* have the wrist very short; but the hand is greatly developed, and is as long as the whole of the rest of the leg, of an oblong form, having a slightly concave palm extending its whole length, bounded at the supero-anteal corner by a tooth-like process, which, however, is only developed in mature specimens, being wholly absent or evanescent in the young; the distal portion of the palm is furnished with two large teeth; finger large, strong, curved, fully as long as the hand; its inner margin, under a high power of the microscope, is seen to be finely crenated, or, rather, rasped like a file. *Pereiopods* having the same general characters as those of the genus *Microdeuteropus*, last pair long, a tuft of hair at the base of the nail, as is usual in the last-named genus. *Telson* tubular, tipped with two or three hairs. *Uropods*: first slightly longer than the second, which, again, are slightly longer than the last, terminating in simple (*i. e.* not hamate) spines; last pair having only a single branch.

The *female* differs widely from the male in the structure of the second pair of gnathopods, which, instead of being the immensely developed organs of that sex, are scarcely larger than the first pair, from which they differ chiefly in the form of the wrist, which is very short, broader than long, and somewhat cup-shaped, the infero-posteal angle being projected into a rounded lobe.

Length hardly exceeding a tenth of an inch, it being one of our smallest Amphipods. Colour yellowish, more or less covered with umber-brown spots; these spots are seen under the microscope to be dendritic; they often form bands across the segments, or at times so coalesce as to make the whole animal appear of a brown colour.

Found among *Laminariæ* at Tobermory, in the Island of Mull, July 1866.

I am indebted to the kindness of Mr. G. S. Brady for the figures of Plate XXI. and a part of those in Pl. XXII.

EXPLANATION OF THE PLATES.

Plate XXI.

Fig. 1. *Haploops tubicola*, Lilljeborg. Last pereiopod, × 40.
Fig. 2. The same. Last uropod, × 40.
Fig. 3. The same. Telson, × 40.
Fig. 4. *Nicippe tumida*, Bruzelius. Gnathopod, × 40.
Fig. 5. The same. Last pereiopod, × 40.
Fig. 6. The same. Telson, × 40.
Fig. 7. *Eriopis elongata*, Bruzelius. Second gnathopod, × 40.
Fig. 8. The same. Last pereiopod, × 40.
Fig. 9. The same. Last uropod (after Bruzelius).
Fig. 10. The same. Telson (after Bruzelius).
Fig. 11. *Mæra Lovéni*, Bruzelius. First gnathopod, × 16.
Fig. 12. The same. Second gnathopod, × 16.

Plate XXII.

Fig. 1. *Mæra Batei*, Norman. First gnathopod, ♂, × 40.
Fig. 2. The same. Second gnathopod, ♂, × 40.
Fig. 3. The same. End of pleon.
Fig. 4. *Tessarops hastata*, Norman, × 16.
Fig. 5. The same. Superior antenna, × 40.
Fig. 6. The same. First gnathopod, × 40.
Fig. 7. The same. Second gnathopod, × 40.
Fig. 8. *Helleria coalita*, Norman. Fore part of body, × 40.

Plate XXIII.

Fig. 1. *Helleria coalita*, Norman. Second gnathopod, × 40.
Fig. 2. The same. Extremity of same, × 85.
Fig. 3. The same. Last pereiopod, × 60.
Fig. 4. The same. Last segment of pleon, × 40.
Fig. 5. The same. Last uropod, × 60.
Fig. 6. The same. Telson, × 63.
Fig. 7. *Microprotopus maculatus*, Norman. First gnathopod, ♂, × 85.
Fig. 8. The same. Second gnathopod, ♂, × 85.
Fig. 9. The same. First gnathopod, ♀, × 85.
Fig. 10. The same. Second gnathopod, ♀, × 85.
Fig. 11. The same. Telson and uropods, × 85.

LIII.—*On two Isopods, belonging to the Genera* Cirolana *and* Anilocra, *new to the British Islands.* By the Rev. A. M. Norman, M.A.

[Plate XXIII. figs. 12–15.]

Crustacea Isopoda.

Fam. Ægidæ.

Cirolana truncata, n. sp. Pl. XXIII. figs. 12–15.

Head much wider than long; greatest width in the centre, at the projection of the eyes, narrower behind and in front, which is slightly tridentate. *Superior antennæ* suddenly bent in a remarkable way at a right angle at the junction of the first and second joints of the peduncle, the first being projected directly forwards, the second directly transversely; third joint

of peduncle much narrower and shorter than the second; flagellum consisting of only about four joints, the first of which is twice as long as the last of the peduncle, and longer than the rest of the flagellum. *Inferior antennæ* very long and slender. *Telson* as broad as long; margins crenulated, distally truncate and denticulate; the two external teeth on each side larger than the row of intermediate ones. *Last uropods* having both branches truncate at the extremity.

Dredged in 40–60 fathoms on a muddy bottom, in St. Magnus Bay, Shetland, in the summer of 1867.

Anilocra mediterranea, Leach.

Anilocra mediterranea, Leach, Dict. des Sc. Nat. vol. xii. p. 350; Desmarest, Consid. sur les Crust. p. 306; M.-Edw. Atlas du Règne Animal de Cuvier, Crust. pl. 66. fig. 1; Hist. Nat. des Crust. vol. iii. p. 257; Savigny, Hist. de l'Egypte, Crustacés, pl. 11. fig. 10; Heller, Carcin. Beiträge zur Fauna des adriatis. Meeres (Verh. d. k.-k. zool.-botan. Gesellsch. in Wien, 1866), p. 19.

Body tumid, boldly arched, surface smooth, polished; colour black, mottled with yellow. *Head* narrower than pereion (which gradually increases in width to the hinder extremity of the fifth segment, whence it narrows posteally), projecting beyond the eyes into a process, which is as long as the rest of the head, nearly square, and bent downwards at the extremity. *Eyes* confined to the sides, their combined breadth not more than equalling half that of the head. *Superior antennæ* not as long as the head, flagellum of four joints. *Inferior antennæ* short, reaching the middle of first segment of the pereion. *Gnathopods* and *pereiopods* glabrous, wholly devoid of spines or hairs; nails strong, hamate, and very sharply pointed. *Last uropods* with the inner branch only slightly exceeding half the length of the outer, subequal in length to telson; outer branch longer than peduncle, and much longer than telson, narrow, subfalciform, glabrous. *Telson* with a slight central keel, depressed near the base, rounded at the extremity, with smooth margins and polished surface. *Length* slightly exceeding one inch.

Found on small fish in rock-pools at Herm in 1865.

I sent a specimen to Mr. Spence Bate, for use in his work; and I conclude that it must have been by some oversight omitted, though the specimen is still in his hands.

EXPLANATION OF PLATE XXIII. figs. 12–15.

Fig. 12. *Cirolana truncata*, Norman. Head and antennæ, ×25.
Fig. 13. The same. Mandible, ×40.
Fig. 14. The same. One of the anterior pairs of feet, ×40.
Fig. 15. The same. Telson, ×16.

LIV.—*Notes on Deep-sea Dredging.* By Edw. Perceval Wright, M.D., F.L.S., Professor of Zoology, Trinity College, Dublin.

Professor Edward Forbes refers, in his 'History of the European Seas,' to "an abyss where life is either extinguished or exhibits but a few sparks to mark its lingering presence." "Its confines," he writes, "are yet undetermined, and it is in its exploration that the finest field for marine discovery yet remains." One sees here, as it were, the hope of some just possible brilliant discovery contending in the author's mind with a dark despair at finding anything beyond a mere spark of life in the great ocean depths, in the so-called azoic regions. Had the amiable author lived even until now, he would have known that many sparks of life are to be met with at depths undreamt of by him, and that the creatures which reside there are not so very much modified as he seemed to anticipate.

The researches of Dr. Wallich, and the publication of the first part of his work on the North-Atlantic sea-bed, have thrown a great deal of light on this subject; a considerable number of deep-sea soundings are recorded or alluded to by him in his interesting volume. But, however valuable they may be, as affording us some slight knowledge of the formation of the sea-bottom at great depths, yet they have not given, nor are they likely to give us any indications of the animals, higher than the Rhizopods, living at these depths: I purposely pass over the occurrence of *Ophiocoma nigra*, O. F. Müll., as recorded by Wallich, as the bringing up of this species from the depth of 1260 fathoms was the result of accident. To afford us any certain knowledge of higher forms, recourse must be had, not to the sounding-line, but to the dredge; and even with it, it will only be after many a tedious and careful exploration that we can expect to arrive at any satisfactory results. It should not be forgotten how very small a surface is scraped by even the largest dredge; and as the deep-sea valleys lie at a considerable distance from the land, the examination of them, except with the assistance of a steamer, is only possible under very favourable circumstances.

In the third or coralline zone of Professor Forbes, though animal life is abundant, yet plants become scarce; and in the fourth or deep coral zone, and at a depth of about 100 fathoms, the only vegetation met with consists of the lowly Nullipores. This latter zone, however, reaches to a depth that I am inclined to place in our seas at about 150 fathoms, increasing another hundred fathoms at the Equator; and it is only below it that we come to a zone of which Professor Forbes knew

nothing—a zone commencing at 300-fathoms mark down to a depth at present quite unknown—a zone in which we now find a very peculiar fauna—one into which some of the fourth-zone animals may wander, but which is still wonderfully well characterized by its own corals and echinoderms, its vitreous sponges, and even its own peculiar fishes. Up to the present I know of no published account of dredging in this zone, except the very interesting paper of Mr. L. F. de Pourtales, Assistant to the United States Coast Survey (for a copy of which I am indebted to the author). The field selected for the researches of Capt. Platt, of the Coast-Survey steamer 'Corwin,' was in a section between Key West and Havana, and the casts of the dredge were made at depths of 270 and 350 fathoms. At these depths many species of Echinoderms, Cœlenterates, and Sponges were met with; and, most interesting fact of all, not only were the long spicules of *Hyalonema* dredged up, but there was also found a fragment of the siliceous skeleton of a sponge, forming a regular network, somewhat like that of *Euplectella*, but lacking the spines. Mr. Pourtales alludes also to a number of sponges (at least a dozen species) which are not yet determined, and says that some of the detached spicules are remarkable for their great size, one of the slender rectangulated sexradiate type of Bowerbank [and doubtless belonging to a sponge of Wyville Thomson's order Vitrea] was found measuring more than half an inch.

We may hope for more information when Professor Wyville Thomson and Dr. Carpenter publish an account of their expedition to the deep-sea valleys off the west coast of Scotland, and when the results of the fourth Swedish expedition shall be known. In the meanwhile I venture to give the following brief notes of a deep-sea dredging-expedition off the Portuguese coast near Setubal.

I had been asked by the Council of the Royal Irish Academy to draw up a report on the present state of our knowledge of that strange organism *Hyalonema mirabile* of Gray, and was naturally anxious to procure living or well preserved specimens of this species.

Professor J. V. Barboza du Bocage, of Lisbon, kindly invited me to pay him a visit at the season for the shark-fishing (in September), promising to place all the specimens of the *Hyalonema* in the museum at Lisbon at my disposal, and to give me every assistance in his power to enable me to go out to the ground where the specimens of *Hyalonema lusitanicum*, Bocage, had been found. Accordingly, after the meeting of the British Association * in August last, at Norwich, I pro-

* A committee was appointed by the British Association, with the

ceeded by Madrid to Lisbon. Having spent some time in examining the very beautiful series of specimens of *Hyalonema* which the energy and zeal of Professor Bocage have collected in the excellent Royal Museum of Lisbon, I went on to Setubal. I had brought out with me a medium-sized naturalist's dredge, for which, I may remark, I had to pay duty while passing through Spain. It is not necessary here to allude to the difficulty of procuring a boat to bring me to the ground, which lies about thirty miles to the south-west of Setubal, which latter is a fishing-village now connected with Lisbon by rail; suffice it to say that, by the kind assistance of Professor Bocage, and of the Deputy Inspector of Fisheries at Setubal, I was at last enabled to procure an open sail-boat and a crew of eight men: we also took on board about 600 fathoms of rope, the dredge, lots of hooks and bait, and provisions for a couple of days. Leaving the port of Setubal a little before 5 o'clock in the evening, we, after a fair night's sailing, reached what the fishermen signed to me to be the edge of the deep-sea valley, where they were in the habit of fishing for sharks, and where, while thus engaged, they had found the *Hyalonema*. It was now about 5 o'clock in the morning; and the men, having had their breakfast, put the boat up to the wind, and let down the dredge; before it reached the bottom, about 480 fathoms of rope was run out, some 30 more was allowed for slack, and then we gently drew it (by hoisting a small foresail) for the distance of about a mile along the bottom. It required the united efforts of six men, hauling the line hand over hand, with the assistance of a double-pulley block to pull in the dredge; and the time this occupied was just an hour. The dredge was nearly full of a tenacious yellowish mud, through which sparkled innumerable long spicules of the *Hyalonema*; indeed, if you drew your fingers slowly through the mud, you would thereby gather a handful of these spicules. One specimen of *Hyalonema*, with the long spicules inserted into the mud, and crowned with its expanded sponge-like portion, rewarded my first attempt at dredging at such a depth. As I purpose presenting to the Academy (as a portion of my report on *Hyalonema*) a detailed account of this

sum of £20 at their disposal, to assist me in this matter, and I had intended applying the money to one day's hire of a steam-tug; but the General Committee having passed a resolution having for its object to make all the specimens of natural history collected by means of its grants the property of the Association, to be disposed of as they should direct, and as I wanted the specimens that I might collect to dissect and cut up for the benefit of science, I thought it better respectfully to refuse the grant, and to decline to serve on the committee.—E. P. W.

and other specimens, I only allude to the discovery of this species here as adding a species to the fauna of the deep-sea zone.

I understood from the men that they had discovered most of the specimens of *Hyalonema* when shark-fishing; but I was not prepared to find sharks at a depth like this; so I was somewhat surprised when the padrone of the boat asked for leave to throw out the fishing-lines, just over the place where we had drawn up the dredge. Some 600 fathoms of rope was let out, the first 30 or 40 fathoms of which had fastened to it, at intervals of a fathom, a series of smaller ropes, on each of which was fastened a large hook, baited with a codling. This fishing-tackle remained below for about two hours, when they commenced to haul it in; when it arrived at the last few fathoms, they pulled in, one after the other, five or six specimens of a shark, each specimen from three to four feet long; the species was the *Centroscymnus cœlolepis*, Boc. & Cap. These sharks, as they were hauled into the boat, fell down into it like so many dead pigs; there was not the smallest motion of their bodies, no switching of their tails, not even a wink of their eyes; and I think there can be no reasonable doubt that they were inhabitants of the same great depth as the *Hyalonema*, and that, on being dragged up through such a weight of water, they were completely asphyxiated. It will not be forgotten how violent all the members of the shark tribe are on being caught. I have watched the boats arriving at daybreak at Setubal after a night's fishing for the surface-living sharks, and, as each boat was emptied of its gory freight, never, in a single instance, did I see any of the hundreds of sharks thrown on shore that had not huge gashes on its head and caudal regions; and these had been inflicted to keep them quiet.

Thus I was enabled to add to the fauna of this deep-sea valley a shark and a sponge; and on the authority of the fishermen I am able to add, still further, a coral and a very remarkable fish. A small hook, baited with a smaller-sized fish than usual, happened accidentally to be fastened to the tackle for catching the sharks, and on the line being drawn up it was found that a small fish (*Chiasmodon niger*, Johnson) had swallowed the bait and hook and a considerable portion of the line. This specimen is now in the Museum of Lisbon, and is, perhaps, the most perfect specimen in any museum. I see no reason to doubt that, if fished for, plenty of specimens of this *Chiasmodon* will be found at these depths; but though, as Dr. Carte has shown*, this fish is very voracious, and

* Proceedings Zoological Society, 1866, p. 35, plate 2.

capable of swallowing a fish twice as large as itself, still it would not attempt to swallow the large fish and enormous hooks that are used in the shark-fishing. I need not say that this fact corroborates Dr. Günther's opinion as to this fish being a deep-sea species.

I am further indebted to Professor Bocage for a specimen of a coral dredged in this same valley. It probably belongs to the family Isidæ, and appears to me to belong to a new genus, which I have described as *Keratoisis Grayii*.

Is it not to these deep-sea valleys that we must look not only for new and strange forms, but even for some of the supposed recently extinct forms, which may be yet found lingering in these abysses, safely there outliving the ravages of time? Professor Sars calls attention to one fact that would seem to point in this direction; for, in a memoir* on the fossil animal remains of the quaternary formation in Norway, he calls attention to the fact that certain remains of marine animals, found in a semifossil condition in these formations, are found living when looked for at certain depths below the existing level of the sea. Professor Sars mentions that the bottom of the Gulf of Christiania, in the neighbourhood of Dröbak, for the space of some three-fourths of a Norwegian square mile, and in an abyss of some 70 or 80 up to some 7 or 8 fathoms in depth, is strewed with *Oculina prolifera*, Linn., occurring in great masses of from one to two feet in diameter: nevertheless not a single living polyp is ever found on these masses; but at the same time they have the appearance of having been comparatively recently torn away from the place where they originally grew. Off the Norwegian coast, however, this very same *Oculina prolifera*, Linn., is found living in great quantities at the depth of 300 fathoms and lower.

LV.—*On the Genera* Cortesia *and* Rhabdia.

By John Miers, F.R.S., F.L.S., &c.

Cortesia.

This genus was established by Cavanilles, in 1797, upon a plant collected by Louis Née in his overland journey from Chile to Buenos Ayres. His account of this little-known plant is upon the whole correct; but, as there are some points of structure unnoticed by him, I will here add the results of

* I only know Prof. Sars's paper from the abstract given in the 'Correspondenz-Blatt des zoologisch-mineralogischen Vereines in Regensburg, 21. Jahrgang, 1867, pp. 72–74.

my own observations made from the living plant in 1825. I found two species—one in dry desert tracts in the neighbourhood of Mendoza, the other fifty miles to the eastward, in saline marshy ground, which is that described and figured by Cavanilles. This genus has been rightly placed in the *Ehretiaceæ*, with which it accords in its tubular calyx, exserted stamens, bifid style, and baccate fruit: it approaches *Tournefortia* in its baccate 2-pyrenous fruit, each nut being 2-celled; but it differs in its solitary flowers, in the singular appendages found between the calyx and corolla, in the absence of a hypogynous disk, in its long bifid style, and in its persistent campanular calyx. The following is an amended character of the genus, from my own observations.

Cortesia, Cav.—*Calyx* tubulosus, carnosus, extus pilosus, intus densissime sericeo-villosus, ore dentibus 10–15 teretibus obtusulis subinæqualibus glabris paulo divaricatis cum membranis brevibus interjectis donatus, demum subcampanulatim dilatatus et persistens. *Appendices* circa 5–10 inter calycem et corollam positæ, squamiformes, inæquales, membranaceæ, ovatæ, utrinque pilosæ, longe unguiculatæ, quorum 1 vel 2 calycem paulo superant, unguibus filiformibus extus pilosis, aut interdum omnes brevissimæ et ideo inter pilos facile invisæ. *Corolla* tubulosa, glabra, membranacea, tubo calycem paulo superante, medio vel sub faucem angustato, limbo ad basin 5-partito, laciniis æqualibus, oblongis, apice rotundatis, subexpansis, æstivatione (cum uno axi remoto exteriore) imbricatis. *Stamina* 5, laciniis alterna; *filamenta* imo dilatata, superne teretia et flexuosa, infra faucem enata, et cum costas totidem prominentes continua, paulo aut longe exserta, erectiuscula, æstivatione induplicato-inflexa: *antheræ* oblongæ, obtusæ, imo breviter divaricatæ, introrsæ, in sinu dorsali affixæ, oscillatoriæ, 2-loculares, loculis ad connectivum latum collateraliter affixis, rima sublaterali dehiscentibus. *Discus* nullus. *Ovarium* superum, pyriforme, imo turbinato-stipitatum, e toro depresso ortum, subsulcatum, placentis 2 oppositis semiseptiformibus bilamellatim introflexis hinc pseudo-4-loculare, lamellis margine 1-ovulatis; *ovula* paulo sub apicem suspensa; *gynobasis* seu columella centralis membranacea, imo ad apicem protensa, libera, demum ad pyrenas adhærens. *Stylus* elongatus, teres, fere ad medium 2-fidus, ramis divaricatis, apice reflexis, æstivatione recurvatis; *stigmata* clavata, tubatim dilatata, rugulosa. *Drupa* obovata, pericarpio subsicco, calyce cupulari semicincta, glabra, nitida, 2-pyrena, *pyrenis* plano-convexis, osseis, 2-locula-

ribus intus sub apicem marginibus utrinque late lamellatim inflexis et hinc in angulo sic abscondito foramine lineari pro vasorum introitu perforatis; *semen* in loculis solitare, funiculo laminiformi suspensum; *integumentum externum* albidum, opacum, tenuiter papyraceum, *raphe* tenui longitudinali angulo interno signatum; *integumentum internum* valde membranaceum, subpellucidum, imo *chalaza* parva inconspicua notatum; *albumen* tenuissimum, in forma membranæ, distinctum; *embryo* oblongo-fusiformis, carnosus, *cotyledonibus* 2, interdum 3, plano-convexis, *radicula* conica ad summum spectante continuis et 3-plo longioribus.

Suffrutices *humiles in provinciis Argentinis locis salitrosis incoli, scabri, rugosi, valde ramosi;* folia *alterna, sessilia, cuneato-oblonga, apice profunde 3-dentata, crassa, enervia, pilis rigidis e tuberculis majusculis albo-crystallinis undique scabra:* flores *axillares aut revera in ramis novellis terminales, solitarii, breviter pedicellati.*

1. *Cortesia cuneata*, Cav. Icon. iv. 53, tab. 377; Lam. Dict. Suppl. ii. 364, tab. 921; DC. Prodr. ix. 512;—suffruticosa, e basi ramosa, ramis adscendentibus, ramulisque tenuibus, subvirgatis, glabris, substriatis; foliis alternis, sessilibus, imo longe cuneatis, apice latioribus et 3-dentatis, dentibus æqualibus, acutis, majusculis, lateralibus incurvatim arrectis, mediano recurvatim deflexo, crasso-coriaceis, enerviis, supra glabris, opacis, subtus tuberculis crystallinis setigeris scabridis, sessilibus, e basi refractis; floribus solitariis, pedicellatis, sæpius terminalibus, rarius axillaribus; calyce extus hispido-pubescente, intus densissime albido-sericeo-piloso, ore dentibus 12–15 munito; appendicibus 5, quarum 1–2 tubum æquant; corolla glabra, tubo medio angustiore, limbo expanso, usque ad basin 5-partito, lobis ovato-oblongis, rotundatis; filamentis imo dilatatis, paulo sub faucem affixis, longe exsertis; antheris oscillatoriis; ovario glabro, imo distincte stipitato; stylo 2-fido, ramis divaricatis dimidio brevioribus; stigmatibus subcapitatis, glanduloso-rugosis; drupa nigra, nitida, calyce cupuliformi semivestita.—In prov. Mendozæ ad Corocorto, et alios locos in humidulis salitrosis: *v. v. et s. in herb. meo et Hook., loc. cit.*(Gillies); in prov. Santiago del Estero, in salitrosis (Tweedie, 1157).

I found this plant growing near Corocorto, a village 130 miles east of Mendoza, in a swampy saline district, where it attains a height of 4 or 5 feet; it is much branched, with straightish, rather spreading or ascending branchlets, which are polished, glabrous, of a reddish colour, slender and substriated. The axils are 3–5 lines apart; the leaves 9–15 lines

long, 5 lines broad across the three lobes, 2 lines broad immediately below them, thence tapering to the base; they are scabrid beneath, with large conical white crystalline tubercles, that bear on their apex a short rigid hair; the solitary flowers are axillary, on a pedicel 3 lines long; the tube of the calyx (3 lines long) has from twelve to fifteen erect terete teeth, $\frac{1}{2}$–1 line long, connected at their base by a short plicated membrane: the five appendices form a simple whorl round the base of the corolla; one or two of them are spathulate upon an elongated slender claw 2–3 lines long and $\frac{3}{4}$ line broad at the apex; the others are sessile, setiform, 1 line long, all sericeously pilose outside, smooth inside; the tube of the corolla is $3\frac{1}{2}$ lines long, the lobes of the border are $1\frac{3}{4}$ line long, 1 line broad; the filaments, fixed just within the mouth, are 2 lines long; the lower part of the style is 3 lines long, its branches 2 lines long; the drupe is ovoid, with a thin coriaceous covering having a saline taste, is 6 lines long, 5 lines broad, half-enclosed within the cupular cup of the persistent calyx; the two plano-convex nucules are 4 lines long, 3 lines broad, hard and osseous, each with two distinct cells with foraminal apertures as above described, each cell containing a suspended seed covered by its colourless integuments; the embryo, enveloped in an extremely thin albumen, has two (sometimes three) equal cotyledons, which are three times the length of the conical superior radicle*.

2. *Cortesia microphylla*, n. sp.;—suffruticosa, humilis, e basi ramosa, ramis imo toruloso-tortuosis, ramulosis, ramulis brevibus, subflexuosis, angulatis, divaricatis, glabris; foliis minoribus, sessilibus, imo anguste spathulatis, canaliculatis, apice dilatatis et 3-dentatis, dentibus acutis, mediano recurvo, lateralibus arrectis, apicibus tuberculo setifero spinulosis, supra subglabris, subtus tuberculis crystallinis setigeris exasperatis, carnosulis, enerviis, horizontaliter patentibus; floribus e ramulis novellis axillaribus 2–4-foliolosis solitariis et semper terminalibus; calyce hispido-pubescente, intus densissime sericeo, ore dentibus 10, acutis, intus planis, extus carinatis, mucronatis, alternis paulo brevioribus; appendiculis 10, breviusculis, setiformibus, villosis, in verticillo corollæ basin cingentibus; corolla membranacea, glabra, tubo cylindrico, calycem æquante, lobis oblongis, rotundatis, suberectis, staminibus medio tubi affixis, paulo exsertis; stylo his longiore, ramis recurvis; drupa subglobosa, calyce ampliato lateraliter fisso semivestita.—Circa Mendozam, in desertam salitrosam: *v. v.*

* A drawing of this species, with analytical figures, will be given in the second volume of the 'Contributions,' Plate 83 B.

This is a shrub of much smaller dimensions and of low straggling growth, collected at a place called the "Plumerillas," in the Travesia not far from Mendoza: it is somewhat prostrate, with several tortuous spreading branches, from 9 inches to a foot long; the younger branches are cinereous, very rough, and more flexuous than in the preceding species; the leaves are less than half the size of those of the other species, more shortly cuneated, horizontally spreading; its flowers are never axillary, always terminal upon short axillary branches $\frac{1}{2}$–1 inch long, furnished with from two to four small leaves; the axils are much closer, only 1 or 2 lines apart. The leaves ordinarily are 3 lines (rarely 5 lines) long, 2 lines broad across the lateral teeth, $\frac{1}{2}$ line broad immediately below them, and thence linear to the base. The pedicel of the terminal solitary flower is very short; the calyx (including the teeth $\frac{1}{2}$–1 line long) is 3 lines in length, the teeth being of a long triangular form, flat inside, without any intervening membranes; the tube of the corolla is 3–4 lines long, the lobes of the border 2 lines long, 1 line broad; the filaments, dilated in the lower moiety, are fixed in the middle of the tube, 3 lines long, and therefore but little exserted; the ovary is 1 line in diameter, supported on a narrow stipitate support $\frac{3}{4}$ line long; the lower portion of the style is 3 lines long, its branches 2 lines long; the ten appendices (nearly equal in size, setiform, 1 line long) form an annular fringe round the base of the corolla. The drupe is more globular than in the preceding species, and the persistent calyx, which half encloses it, is split on one side to the base.

Rhabdia.

This genus was founded by Von Martius, in 1826, upon a Brazilian plant which he described and figured in his Nov. Gen. ii. 136, tab. 195; he placed it in *Ehretiaceæ*, where also it has been arranged by De Candolle and other botanists. Fresenius, in his memoir published thirty-one years afterwards in the 'Flora Brasiliensis,' absolutely ignored the peculiar seminal structure, which had been so well described by Von Martius. His diagnosis of *Rhabdia* is very short and unaccountably incomplete; he merely regarded it as an aberrant genus between *Heliotropieæ* and *Cordiaceæ*. My own observations fully confirm the accuracy of the peculiar structure of the fruit and seed as it is minutely described in the work of Von Martius. The placentation of the ovary is like that of *Amerina*; that is to say, it is unilocular, with two opposite parietal placentæ, which project inwards towards the centre, where they do not meet, but are bifidly spread and

turned backwards, each margin havinga single ovule attached to it. The fruit is a succulent drupe containing four nucules, evidently at first combined together in pairs, and afterwards free; upon one margin only of each nucule, always on the contiguous side of each pair, there is seen a fungous longitudinal line, which penetrates the cell through an open corresponding slit; and upon this fungous line the single seed is attached, at a small spot halfway between the middle and the summit: this fungous line seems to belong to the original placenta seen in the ovary. The seed is long, pointed at both extremities, and on its outer integument a line of raphe is seen running from the point of its attachment to a small chalaza at the base; its embryo, enveloped in solid albumen, has a small superior radicle and two oblong foliaceous cotyledons, with their face turned to the centre of the fruit. One important part of this structure is the axile column, or, as some would call it, the gynobase, although it is in the form of a spindle-shaped vesicular membranaceous tube, originating at its base in the extremely small torus, and terminating at its summit in continuity with the persistent style, where it also unites with the pericarpial covering of the fruit; it has four distinct longitudinal cords or bundles of spiral threads terminating in the style, some of which adhere to the fungous lines seen upon the nucules; this tube touches the smooth ventral faces of the nuts, without absolutely adhering to them; there is no trace of any basal gynobasic attachment of the nuts, which do not even touch the torus.

It has been already noticed (*suprà*, p. 123) that this structure cannot be reconciled either with the *Heliotropiaceæ* or with *Ehretiaceæ* under the conditions hitherto supposed to exist. The reality of the organization above described is, however, unquestionable, being clearly illustrated by Von Martius in the work referred to, in like manner depicted by Dr. Wight (Icon. 1385) and by Sir Wm. Hooker (Icon. 823). In searching for a parallel structure, we naturally come upon the *Hydrophyllaceæ*, with which *Rhabdia* agrees in having a deeply 5-cleft calyx, a campanular corolla with a 5-lobed border, five equal subexserted stamens affixed near the bottom of the tube of the corolla, 2-lobed anthers, a simple style with a 2-lobed stigma, a superior 1-celled ovary with a parietal placentation, as before explained, and albuminous seeds enclosing an embryo with a superior radicle: but here the analogy ceases; for it differs in its suffruticose virgate growth, the stems crowded with simple, almost sessile leaves, the want of scales in the tube of the corolla, and in the totally different structure of the fruit.

In regard to its real affinity, it is clear that the peculiar placentation just described would remove it far from the *Ehretiaceæ*, under the supposition that the carpical structure of the latter accorded with the rule that has been hitherto understood: but it is quite otherwise; for a more searching examination into the structure of *Ehretia* and its congeners has revealed the fact, which I shall be able to demonstrate, that there is little difference in their placentation from that of *Rhabdia* and *Cortesia*. Consequently *Rhabdia* will still remain a member of this family.

There is, however, a wide distinction between *Ehretiaceæ* and *Borraginaceæ* (*Borragee* of De Candolle), the latter of which ought certainly to stand as a family distinct from all the tribes associated with them in the 'Prodromus,' because they differ essentially in the peculiar gynobasic disposition of the carpels. By adopting as a basis of arrangement the various modes of organization of the carpels, the *Hydrophyllaceæ* would still occupy the place assigned to them by De Candolle; but if we transpose the *Polemoniaceæ*, *Convolvulaceæ*, and *Erycibeæ* (all with an inferior radicle) to a more suitable position, a more satisfactory arrangement will be attained. The *Ehretiaceæ* osculate with the *Borragineæ*, and approach the *Heliotropieæ* in their distinct carpels and simple style. Though it may be impossible to express the relative degrees of affinity of these several groups in a lineal series, the following would be a nearer approach to it than any hitherto proposed. Thus we should have—*Cyrtandraceæ*, *Hydrophyllaceæ*, *Ehretiaceæ*, *Borragineæ*, *Heliotropiaceæ*, *Cordiaceæ**, *Hydroleaceæ*, *Erycibeæ*, *Convolvulaceæ*, *Polemoniaceæ*, *Scrophulariaceæ*, &c. In this manner the pentandrous hypogynous *Monopetaleæ* with two or four carpellary ovaries and a superior radicle all fall into one continuous series, with more harmonious steps of transition, while those with an inferior radicle are made to follow.

Rhabdia, Mart.;—*Ehretia* in parte auct.—*Sepala* 5, subæqualia, lanceolata, persistentia, æstivatione imbricata. *Corolla* subcampanulata, imo tubulosa, ad medium 5-loba, lobis oblongis, subacutis vel rotundatis. *Stamina* 5, lobis alterna, ad basin tubi inserta; *filamenta* filiformia, tubo longiora; *antheræ* ovatæ, erectæ, 2-lobæ, lobis ovatis, collateraliter adnatis, rima longitudinali introrsum dehiscentibus. *Discus* minimus, glandulosus, simplex aut nullus. *Ovarium* superum, conico-ovatum, septis 2 incompletis e

* In this interval should be placed a new family, the *Auxemmaceæ*, which will be shortly described.

pariete oppositis divaricatim bifidis marginibus uniovuligeris, hinc pseudo-4-loculare, *ovulis* appensis, *micropyle* supera: *gynobasis* seu columella centralis tubulosa, vacua, vasis ad ovula pertingentibus munita. *Stylus* filiformis, longitudine staminum. *Stigma* parvum, 2-lobum et subpeltatum. *Drupa* ovato-globosa, nitida, parce succosa, calyce persistente inclusa, 4-pyrena; *pyrenæ* oblongo-ovatæ, dorso convexiores, per paria medio lineæ placentaris fungosæ margine semiadhærentes, mox liberæ, subosseæ, uno margine rima longitudinali pro intrusione vasorum oblique fissæ, 1-spermæ: *semen* loculum implens, *hilo* punctiformi conspicuo inter medium et summum appensum; *integumenta* tenuissima, alba, opaca, *raphe* ab hilo ad *chalazam* parvam basalem percursa; *embryo* in *albumine* carnoso inclusus, *cotyledonibus* foliaceis, ovatis, faciebus diametro fructus parallelis, *radicula* tereti ad summum spectante 2–3-plo longioribus.

Suffrutices *Brasilienses et Asiatici:* caules *plurimi*, *congesti*, *erecti*, *virgati*, *subramosi*, ramis *adscendentibus;* folia *plurima*, *alterna*, *lineari-oblonga*, *sessilia*, *aut brevissime petiolata*, *subpuberula;* racemi *in ramulis novellis terminales*, *pauciflori;* flores *parvi*, *breviter pedicellati*, pedicellis *medio bracteatis.*

1. *Rhabdia lycioides*, Mart. Nov. Gen. ii. 136, tab. 195; DC. Prodr. ix. 512; Fresen. in Mart. Fl. Bras. xix. p. 58, tab. 9. fig. 9;—caulibus plurimis, congestis, erectis, ramosis; ramis adscendentibus, virgatis, elongatis, breviter ramulosis; ramulis apice floriferis; foliis sparsis, sursum gradatim minoribus, lineari-oblongis, apice obtusis aut breviter acutis, imum versus latioribus et rotundato-truncatis, marginibus undulatis, sessilibus, erecto-patulis, utrinque pubescenti-hirtis, pilis præsertim subtus imo tuberculatis, subtus pallide viridibus, costa prominente viridi-rubescente pubescenti-hirtula: racemis in ramulis novellis terminalibus, brevissimis, simplicibus vel 2-fidis, 2–3-floris, pedicellisque imo bracteatis et calycibus molliter pilosis; floribus imo bracteolatis; bacca globoso-ovata, nitida, coccinea. — In Brasilia prov. Bahia, Rio S. Francisco, in inundatis prope Joazeiro. (*Non vidi.*)

Martius describes this species as growing in numerous cespitose upright branches, 5 or 6 feet high; these throw out several erect branchlets, which are again ramified: the leaves are alternate, 4–6 or 8 lines apart, 1–1½ inch long, 4–5 lines broad; the bracts are 1½ line long; the sepals 1½–2 lines long; the corolla 2½ lines long, the tubular part being white, the

lobes of a dark rose-colour; the ovary, seated on a small fleshy disk, is 1 line, the style 2 lines long; the crimson berry encloses four small nuts imbedded in a small quantity of pulp. It was found in flower and fruit in the months of March and April. Its vernacular name is *Apicum*.

2. *Rhabdia crebrifolia*, n. sp.;—ramis teretibus, nudis, fuscis, glabris; ramulis brevibus, imbricatim foliosis, novellis puberulis; foliis lineari-oblongis, a medio ad basin sensim angustatis, superne subacutis, cum acumine brevissimo canaliculatim reflexo, integris, utraque facie opacis, pallide concoloribus et pilis simplicibus molliter puberulis, crassis, fere enerviis, costa subtus prominula, primum erectis, dein subreflexis, petiolo tereti, puberulo, limbo 15-plo breviore: racemulis in ramulis novellis terminalibus, brevibus, intra folia dense imbricata fere absconditis, alternatim 4–5-floris; pedicellis brevibus, imo bractea majore, medio bracteola lanceolata pilosa donatis; calyce ebracteato, profunde 5-partito, lobis oblongis, acuminatis; bacca subglobosa, nitente, calyce persistente inclusa.—In Brasilia: *v. s. in herb. Mus. Brit. et Hook.*, prov. Ceará (Gardner, 1793).

This plant, somewhat resembling the preceding, was found by Gardner on the sandy banks of the Rio Salgado, near the town of Icó, in August 1838. It differs in its closer, more imbricated, smaller leaves, narrowed at the base, upon a very short petiole, and not sinuated on the margin. The branches are generally of no great length; but the flowering branchlets, seldom more than $1\frac{1}{2}$ inch long, and 4–6 lines apart, are thickly covered with imbricated leaves, and bear a single raceme almost hidden at their extremity; the leaves are 6–8 lines long, $2\frac{1}{2}$ lines broad, narrowing gradually towards the base into an extremely short petiole; the raceme is 4–8 lines long, with four or five alternate flowers, upon pedicels $\frac{1}{2}$–1 line long; the basal bract is 3 or 4 lines, the median one 2 lines long; the calyx is shortly campanular at its base, and cleft into five equal erect segments somewhat imbricated in æstivation, broader in the middle than at the base, and very acute, 2 lines long, smooth inside, covered outside with short soft hairs emanating from minute tubercles, and with ciliated margins; the corolla is very deciduous, its tube 1 line long, its border somewhat campanulate and reflected, has five lobes $2\frac{1}{2}$ lines long, $\frac{3}{4}$ line broad; the filaments, glabrous, fixed near the base of the tube, are 2 lines long; the anthers subglobose and didymous; there is no disk, but the subglobose ovary is shortly stipitated; the style is compressed, 2-grooved, the length of the stamens, and persistent; the flat peltate stigma is 2-lobed,

the drupe, subglobose, 4-grooved, slightly compressed, is 1 line in diameter, with a polished submembranaceous lax pericarp, apparently filled with mucilaginous juice which disappears in drying, enclosing four nucules, as before explained, attached to a membranaceous ventricose central column.*

3. *Rhabdia viminea*, Dalz. in Hook. Icon. tab. 823;—Ehretia (Xerodema) viminea, *Wall. Cat.* 906; *DC. Prodr.* ix. 569; —Ehretia cuneata, *Wight, Icon.* iv. tab. 1385;—ramosa, ramis teretibus, vimineis, adpresse setosis; foliis alternis, copiosis, cuneato-oblongis, apice rotundatis et brevissime mucronatis, supra glabris, subtus adpresse setosis; petiolo limbo 10-plo breviore: racemis in ramulis novellis terminalibus, brevissimis, 2–3-floris; pedicellis brevibus, imo bracteatis; sepalis lanceolatis, pilosis; corolla breviter tubulosa, limbi lobis oblongis, apice rotundatis, campanulatim expansis; antheris lineari-oblongis, exsertis; drupa parva, pallida.—In India orientali, provv. Martaban, Madras, et Malabar.

This, according to Dr. Wight, is a small, very branching shrub, growing on the sandy banks of rivers, like the two preceding species. The drawings of Wight and Hooker quite agree in all points of structure with the figures given by Martius of the typical species. The axils are 2–3 lines apart; the leaves are 8–10 lines long, 3–3½ lines broad, on a petiole ½ line long; the flowering branchlets are ½–¾ inch long; the sepals are lanceolate, canaliculate at the apex, 3 lines long; there is no disk; the form and structure of the ovary, style, fruit, and albuminous seeds as in the typical species.

LVI.—*Notes on the Bats of the Seychelle Group of Islands.* By Ed. Perceval Wright, M.D., F.L.S., Professor of Zoology, Trinity College, Dublin.

The Seychelle Islands would appear to be destitute of Mammalia, if we except two species belonging to the order Cheiroptera. One of these is the well-known *Pteropus Edwardsii*, which is very common on all the islands of the group. The Flying Fox is a favourite food of the creole inhabitants: I never shot a specimen that the body was not eagerly demanded by my cook. When skinned within a few minutes after death, and roasted the same day, the flesh, though dark, is very good. I have often seen and several times shot these bats flying in strong sunlight between 8 and 10 in the morning; but though

* A representation of this species, with ample structural details, will be given in Plate 84 of the 'Contributions to Botany.'

this is often the case, yet, as a rule, they are nocturnal in their habits. About an hour before sunset they may be seen flying at great heights from their resting-place in the woods, towards the groves of the tree producing the "fruit de Cythère" (*Spondias cytherea*) or the mango-trees (*Mangifera indica*), which are generally found growing not far from the dwellings of the planters; but almost any fruit is equally welcome to them, and they are anything but welcome visitors to the neighbourhood of a fruit-garden. I recollect once taking up my position in a secluded spot near some fruit-trees that I knew were each evening visited by the bats: they began to arrive about 5 o'clock; at first only one or two made their appearance, and they took up good places, with plenty of fruit near them, and alighted without noise; they, like all the others, flew very high, and made as if they were going to cross the island, and then, when just over the group of trees, they fell down as it were among them. By-and-by the arrivals were more numerous, and then the noise began; for a late comer would try to dislodge an earlier comer, and this not without much growling and grumbling and chattering. A little after sunset the noise was at its highest, and there were no more arrivals. At this time I calculated that there were about a hundred and twenty bats in the group of trees. Coming from my place of concealment, I disturbed the multitude, and they fell off the branches at once, and commenced flying in circles round the trees, gradually returning to their meal as I vanished in the distance. I was told that a Flying Fox with a perfectly black face was to be found on Isle Félicité; but though I spent several days on this island, and shot specimens on it of the ordinary *P. Edwardsii*, I never saw a specimen with a dark face.

The second bat belonged to the insectivorous suborder, and was very common in the neighbourhood of the town of Port Victoria, though very difficult to procure. It had a habit of flying round the clumps of bamboo towards twilight, just as the little pipistrelle or the long-eared bat of this country around trees. But in the daytime it was to be found resting in the clefts of the mountain-side facing the sea and with a more or less northern aspect; and these hiding-places were generally covered over with the large fronds of *Stevensonia grandifolia* and *Verschaffeltia splendida*. I sent a specimen of this species to my friend Professor Peters, of Berlin, who informed me that he was writing a monograph of the Cheiroptera; and he describes it as a new species as follows*:—

* Monatsbericht der Königl. Akademie der Wissenschaften zu Berlin, June 22, 1868, p. 367.

Coleüra sechellensis, n. sp., Peters.

This species is not only considerably larger than *Coleüra afra*, but it also differs in the spurs being proportionally much shorter—not so long as the tibiæ, but about one-third shorter. The colour is a sooty brown. The following are the measurements:—

	metre.
Total length	0·080
Head	0·021
Height of ear	0·011
Breadth of ear	0·005
Tragus	0·019
Tail	0·028
Upperarm	0·0565
Forearm	0·011
Thigh	0·020
Leg	0·023
Foot	0·0105
Spur	0·0165
Leg-membrane across the middle	0·033

I found this bat on Mahé, Praslin, Silhouette; and I believe it to be the only insectivorous bat to be met with in the islands.

LVII.—*Notes on the Transportation of Living Fish from South of the Equator to Europe.* By Ed. Perceval Wright, M.D., F.L.S., Professor of Zoology, Trinity College, Dublin.

My very good friend Dr. J. E. Gray records, in the 'Annals' for October last (*anteà*, p. 319), the fact that Mr. Moore had succeeded, in September, in importing into Liverpool from the River Plate the first living fish that had been received from the south of the equator. This note brought to my mind the fact that I had succeeded in bringing as far north as Paris, in the month of December last (1867), specimens of the only freshwater Cyprinoid of the Seychelles Islands, i. e. *Haplochilus Playfairii*, Gthr.; and as it is a matter of some interest that the results of all such experiments should be recorded, and the means adopted for carrying them out known, I venture to give here the following extracts from my notebook:—

"This little fish is rather common in the mountain-streams on the eastern side of Mahé. These streams are perennial; but

they flow in very deep rocky channels which are sometimes filled up by immense boulders or blocks of granite which have fallen off from the mountain's side; the stream then flows silently beneath them, reappearing at some distance. Here and there, as the water makes its way over some projecting ledge of rock, there will be a tiny waterfall, and below this a deep rock-pool. It is in such that these little fish abound. Large specimens will be met with about four inches in length, but in general they are not more than about three inches long. The colour of the body in an adult specimen is a light olive hue; but the opercular bones are streaked with red lines, and seven longitudinal rows of red spots correspond to the series of scales. The red on an olive-coloured ground has a very pretty effect; and *Haplochilus Playfairii* would be a very pleasing addition to our freshwater aquaria. These fish were easily caught with a small water-net; they were of an inquisitive turn of mind; and when I let the net float for a few moments in the water, it was always sure to be inspected by some of the older fish, who would even go so far as to enter it—a fact of which I generally took advantage, and, drawing the net in, would transfer them to a bottle of spirits. One little stream (the one which supplied the Government Hospital and Dr. Brooke's house, in which I was residing, with water) abounded with these fish; and as the stream was not far from the house, the thought struck me, would it not be possible to keep them in an aquarium, and watch their habits. The great heat, however, was against this, and specimens brought home to live generally died very soon, so that I despaired of ever bringing any to Europe alive. However, the day before the mail for Europe was expected, I took a dozen of them from the nearest rock-pool, and placed them in a large foot-bath in my bed-room: the next morning three were dead. The 'Erymanthe' made her appearance in the roadstead about 1 o'clock, and I was obliged to go at once on board. I had a vast number of packages, including a young leopard, now in the Zoological Gardens, which had been brought from Zanjibar and was given to me by my friend Commander Bradshaw, of H.M.S. 'Star,' and some three dozen birds; and it was with some difficulty that I succeeded in bringing with me a small eight-ounce glass jar with the nine fish. A sail of about an hour brought us to the mail-steamer; and when, after some necessary delays, I got on board, they were all still living. I was not on board many minutes when I found that the 'Erymanthe' would not start until early the following morning, so as to allow the Bishop of Mauritius to have service on shore and to take farewell of the Seychelles; and as the bishop was to be

my guest for the day, I returned once more to shore. It was about 10 o'clock in the evening when I again got on board, and in the meanwhile two of my fishes had died. I placed the rest in a water-jug; and though they were in rather a sickly condition, they soon revived; one, however, jumped out of the jug unnoticed, and thus lost his life; the remaining six lived on, in apparently the best of health, until I reached Suez. The fresh water in the Seychelles is very full of iron; the water on board the 'Erymanthe,' from being kept in iron tanks, was also impregnated with the same metal; and I was in the habit of pouring out a quantity of the water each morning, and filling the jug up again with fresh water let fall from some distance, so as to aërate it as much as possible. Every fly caught on board was given to the fishes; and I took advantage of my few hours sojourn at Aden to lay in a small store of insects, with which to regale them while in the Red Sea. At Suez I was detained for some time by the custom-house officers, but at last succeeded in getting the fish, birds, and leopard (it went by the name of a cat) into a railway carriage otherwise unoccupied. Just as the train was about to start, the officials came to take the leopard from me; but by this time I had let her loose in the carriage, and when she saw their dark faces (she never had at best a fancy for blacks), she jumped up to get at them in a manner that so alarmed them that they at once ran away and left us alone. After a few hours railway travelling, I found the fish beginning to gasp for air; the motion of a railway carriage so churns the water, that it soon becomes unbreathable. I, however, changed the water at Cairo, and brought them alive to Alexandria: here I placed them for a couple of days in a glass vase of Nile-canal water; but, whether from its coldness or from its being so full of mud I know not, in one night two died. I then got some rain-water, placed a piece of iron in it, and left it in the kitchen of my friend's house, and the others seemed to be all right. From Alexandria to Marseilles we had a very cold and stormy passage; but still I landed at Marseilles with my four fish alive; they went with me to, and spent a whole day and night at Hyères, and they then commenced what was to them a journey of death towards Paris. The jolting of the express train was very great, and ere we reached Lyons two had died: here I changed the water, and had still hopes of bringing the remaining two to London. To avoid the shaking as much as possible, I had suspended the bottle from the ceiling of the coupé; but at Dijon a lot of people got into it, and I was obliged to bundle up all my possessions into a small corner on the floor; and so it happened that when daylight dawned, and we stopped

at the terminus on the Boulevard Mazas, the *Haplochili* had gasped their last, and could only be said to have just reached Paris to die. I have wondered several times since, what became of these two. They were good specimens; their colours were not as bright as if, instead of being choked or drowned in water, they had been drowned or choked in spirits; but the bottle had on it a label with their name and country, and I left it behind me in the railway carriage."

Thus my experiment failed; but I doubt not that, with a little more care, it would have succeeded; and I feel sure that ere long this pretty freshwater fish will be brought into France, and so make its way into England. The intelligent and energetic officers in charge of the mails between Réunion and Paris have many facilities for carrying this project into effect; and as there is only three days of the three weeks' journey to be accomplished by rail, the difficulties of railway transit are not insurmountable. My belief is that this little fish would become a great favourite in this country. I would commend the subject to the consideration of M. Geoffroy St. Hilaire, the able Secretary of the Jardin d'Acclimatation of Paris. With such zealous assistants as he has in my friends Capt. Rappatel of the 'Erymanthe,' and M. Richard, Agent de l'Administration des Postes, he need experience no difficulty in having brought to Paris any of the land or freshwater vertebrates to be met with in the islands off the east coast of Africa.

LVIII.—*Descriptions of some new Genera and Species of Alcyonoid Corals in the British Museum.* By Dr. J. E. Gray, F.R.S., V.P.Z.S., &c.

Some years ago we received from Mr. Jukes some animals in spirits. Amongst these is a fleshy Alcyonoid, which lives on the naked axis of a *Gorgonia* apparently belonging to a genus and species that I have not before seen described. Unfortunately the specimen has no habitat attached to it, and it is not in a very good state; so I have been waiting in hope of another specimen arriving in a better condition and with its locality stated; but being now engaged in naming the undetermined species of this group, I shall proceed to describe it.

This Alcyonoid has much resemblance to the genus *Nephthya*; but it differs in the slenderness of the branches and branchlets, the distance between the polypes, and the outer surface of the polypes being entirely destitute of fusiform and other spicules.

LEMNALIA.

Coral soft, fleshy, formed of numerous clustered, small, cylindrical tubes; the outer surface is smooth, destitute of any appearance of spicules, but showing by grooves the places of union of the different tubes that form the mass, each tube ending in a polype. The base is broad, expanded horizontally, fleshy like the coral, throwing up several stems, which are irregularly branched, the lateral branches being somewhat two-rowed, the terminal branchlets rather clustered, each branchlet ending in a short cylindrical polype, the mouth and tentacles of which are completely retractile, only leaving a central knob surrounded by eight slightly depressed radiating grooves, and entirely destitute of any appearance of superficial spicules. The whole coral is flaccid, and the larger branches appear to be more or less compressed; but this may in great part depend on the state of the specimen.

Lemnalia Jukesii. Fig. 1.



Hab. ——? (J. Jukes, Esq.)

Ammothea thrysoides, Hempr. & Ehrenb. (Ehrenb. Corall. r. M. 59), from the Red Sea, may be another species of this genus.

Prof. Ehrenberg, in his 'Corals of the Red Sea,' separates the genus *Ammothea* from *Nephthya*, because the former is said not to have, and the latter to have, fusiform spicules on the polype. The types are *A. virescens* and *Nephthya Chabrolii*, Audouin, both from Savigny's beautiful figures in the great work on Egypt, t. 2. f. 5 & 6; but, if the figures are examined, it will be found that Savigny represents the polype-cells of both species as covered externally with fusiform spicules, the spicules in *Ammothea* being only smaller than those of *Nephthya*. Prof. Ehrenberg says that he has examined many specimens

of *Ammothea*; but he does not point out the inconsistency of Savigny's beautiful figures with his generic character.

MM. Milne-Edwards and Haime, in the 'Coralliaires,' have placed *Ammothea* with the "Alcyoniens nus" and *Nephthya* with the "Alcyoniens armés;" yet, as has been pointed out by MM. Duchassaing and Michelotti (Coral. des Antilles, p. 9), they seem to be only synonyms of the same genus. Probably these authors were misled by Prof. Ehrenberg's characters of the genera above quoted.

Filigella.

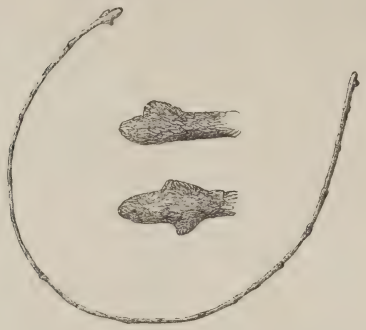
Coral free, filiform, simple, slender, rather rigid. Bark thin, transparent, formed of a single series of flattened, subfusiform, elongate spicules placed close together side by side, forming a hard coat; ends blunt, ovate, covered with spicules like the stem. The axis hornlike, slender, cylindrical. Polype-cells short, broad, conical, very far apart, those next each other being on different sides of the stem, forming a subspiral series covered with a single series of close spicules like the bark. The cells near each end of the coral are very much alike, and the ends of the coral very similar and covered with spicules; but there does not appear to be any opening for the polype: they are probably the buds by which the coral grows in length.

How the coral lives I am not able to divine. There is no appearance of either of the ends being sunk in the sand; and there is no expanded disk, which is universal in the group to which it belongs. It must live erect, or nearly so; for the polypes are placed equally on all sides of the axis. Can it climb among the branches of zoophytes or corals?

The specimens of this Gorgonoid coral I found among some *Pennatulæ* dredged up from off Cape Frio, near Rio de Janeiro. It is curious as being simple, thread-like, unbranched, and rounded off at each end; so that it must have been free. It is covered with a single regularly disposed series of small, fusiform, flattened spicules, closely applied to each other. There are a small number of very distant, short, broad, conical polype-cells, which are also covered with a single series of spicules. One of these cells is near each end, and it and the end of the coral are covered with spicules like the rest of the stem.

In the structure of the bark and the form and disposition of the polype-cells it is very much like the genus *Acis*, described and figured by Duchassaing and Michelotti (Coral. des Antilles, p. 19, t. 1. f. 14,15); but it differs from that genus in being unbranched and free.

Filigella gracilis. Fig. 2.



The coral very slender, thread-like; the polype-cells about one inch or three-quarters of an inch apart.

Hab. Coast of Brazil and Cape Frio. B.M.

Cirrhipathes filiformis.

Coral very slender, thread-like, of equal diameter from end to end, pale brown, with crowded spinules on the surface; the spinules are conical, nearly transparent, and spread out nearly horizontally from the axis.

Hab. Australia.

This specimen was found among some reptiles &c. purchased from Mr. Higgins, from Australia.

Mr. Jukes, in 1846, presented to the British Museum some corals that were collected by him on the north coast of Australia: among others, there are two very interesting new genera allied to *Melithæa* and *Isis*. They differ from all the other genera of the group in only having a single series of polype-cells on each of the two edges of the branches and branchlets.

Fig. 3.



Acabaria divaricata.

ACABARIA.

The coral very slender, branched, dichotomous, expanded in a plane; branches and branchlets very slender, compressed, with short, swollen joints, more prominent on the older stems. Bark thin, hard, smooth. Cells short, broad, subcylindrical, truncated, in a single series on each edge of the branches and branchlets, rather close together. Axis calcareous, solid, red, longitudinally grooved; internodes short, swollen, spongy.

This differs from all the other genera of Melithæadæ in having a single series of separate well-developed polype-cells on each of the two edges of the branches and branchlets.

Acabaria divaricata. Fig. 3.

Coral very slender, fan-like, branched; branches rather elongate, divergent; bark red-brown; axis rose-coloured.

Hab. Australia. (Jukes, no. 2787.) B.M.

Anicella.

Coral fan-like, dichotomously branched; branches separate, divaricating, in the same plane, arising from the short, rather sunken joints. Bark thin, hard, smooth, longitudinally grooved. Cells minute, subcylindrical, short, produced in a narrow alternating series on each edge of the branches and branchlets. Axis calcareous, solid, with longitudinal grooves; internodes very short, contracted, bark-like.

This genus differs from *Melithæa* in the bark being smooth, and the internodes not swollen, and from *Isis* in the internodes being bark-like and not cartilaginous.

Anicella australis. Fig. 4.



Coral red, growing in one plane; the stem distinctly jointed; the branchlets slender, with the joints very inconspicuous.

Hab. Port Essington. (Jukes.) B.M.

LIX.—*Notulæ Lichenologicæ.* No. XXV.

By the Rev. W. A. Leighton, B.A., F.L.S.

On the Germination of the Spores of Varicellaria*.

By Dr. W. Nylander.

Tulasne and De Bary have already written concerning the germination of the large-sized spores of Lichens, and have seen slender filaments extruded gradually on all sides from the walls of the spore, which filaments these celebrated authors regard as the first hypothalline developments, or beginnings of the thallus.

I have also seen the spores of *Varicellaria* (which are almost the largest-sized spores of all Lichens—see Nyl. Lich. Scand. t. 1. f. 8), when placed in a humid atmosphere or covered with water, to be similarly covered in a short time with slender circumradiant filaments. But at the same time I have seen other similar filaments to issue from the various adjacent fragments of the disrupted apothecium of *Varicellaria*. After a month's time, in some spores, these filaments (both those of the spores and of the other fragments) manifestly acquired a mucedinous character, and produced moniliform, hyaline, penicillate acrospores, and thus constituted a slender *Penicillium*. Afterwards, by continued culture, I have seen this *Penicillium* destroyed and vanishing away. But long before that, and contemporaneously with the protrusion of the filaments above mentioned, I have observed in the endospore a hyaline protoplasm, turbid in the middle, composed of very minute white granulations, which, as it were by coagulation, formed a solid white corpuscle (opake as seen against the light) in the cavity of each cell of the spore—and that this afterwards gradually increased after the fashion of an embryo, and at length in the third month filled the entire cavities of both cells of the endospore. At the same time the wall of the two cells showed the concentric strata to have become sensibly looser, and was fissured by frequent fine transverse rimulæ (or strigulæ) (which same thing De Bary has observed, and which I myself have noted in *Pertusaria velata*, in Lich. N. Zeal., in Linn. Soc. Journ. ix. p. 253), preparing for its future dissolution, which a parasitic mucedinous vegetation would also promote. From the middle of the month of March to the middle of the month of June I have noticed these phenomena. The spores, then denuded of the filaments of the *Penicillium* (whose vegetation had passed away) displayed in the interior of each cell

* Translated from 'Flora,' Sept. 10, 1868.

a white corpuscle, which, towards the septum separating the cells, in most spores stretched out the sporal wall on one side. Thence I sometimes saw a white oblong corpuscle spontaneously expelled from either cell. When free (or partly remaining within the cells and partly protruded near the septum), these corpuscles became larger, and especially longer, than when enclosed within the spore, somewhat deformed, and unequal or almost cerebriform on the surface, but covered by no cellular membrane.

Here, unless I am deceived, is the beginning of the thallus of the Lichen; but I have been unable to pursue the ulterior evolution. Does, then, fecundation take place in these corpuscles? Their analogy would then be with the spores of the Fucaceæ.

Subsequently, in the warm summer, I experimented with other cultivations of the spores of *Varicellaria*; and, as in the former ones, I beheld the mucedinous filaments speedily and copiously evolved from all. But now the fructification of *Helminthosporium* (spores septate, black, pyriform, moniliformi-proliferous, subfasciculate) appeared in these filaments, and the sporal wall became dissolved in a short time. Sometimes the corpuscles assumed a rose-colour. Too much heat (often about 30° C.) was injurious to this culture.

Observations of this kind are very easily instituted and explained; but in such experiments the natural conditions are so imperfectly imitated that consequently it is most difficult to attain to any knowledge of the physiology of Lichens.

Corrigenda.

In Dr. Nylander's paper on "Lichens in the Luxembourg Gardens" (Ann. & Mag. Nat. Hist. ser. 4. vol. ii. p. 245), I have inadvertently made some gross mistakes, which need correction:—

Page 246, line 5, *for* "hygrometer" *read* hygiometer.

Page 248, line 31, for "*Lecanora umbrina* = *Lecidea pelidna*, Ach." read:—*Lecidea umbrina* is identical with *Lecidea pelidna*, Ach., which latter name is to be preferred for this lichen, because we have a *Lecanora umbrina* (Ehrh.) and because it is desirable to avoid a similarity of nomenclature in genera which approach so closely to each other.

For "Heppe" *read* Hepp *passim*. W. A. Leighton.

LX.—*Reports on Dredging.* By J. Gwyn Jeffreys, F.R.S.

I have not much to say in answer to the remarks made by Mr. M'Andrew in the last Number of the 'Annals,' because it seems to me that we do not differ in any very material point.

With regard to "bathymetrical" zones (in which, of course, I did not mean to include that part of the shore which lies "beyond the reach of ordinary tides"), I am satisfied with my friend's admission that "the same species often frequent different depths in different seas:" from my own experience in dredging (now of between thirty and forty years), I would say the *same* seas. I am not a disbeliever in zones, having, in my work on 'British Conchology,' adopted and endeavoured to define four,—viz. littoral, laminarian, coralline, and deep-sea; but the first two and last two of these constitute two principal zones, which may be termed littoral and submarine. Some species of Mollusca, as well as of other animals, range from low-water mark to the greatest depth reached by the dredge.

The question as to the comparative size of northern and southern specimens of the same species was so fully discussed by us in the 'Annals' for 1860, that it is unnecessary to continue the controversy. I would, however, observe that perhaps our disagreement on this point may in some measure arise from my considering certain forms mere varieties which other conchologists hold to be distinct species. I have elsewhere given my reasons for uniting *Pecten septemradiatus* with *P. clavatus*, *Lima hians* with *L. tenera*, and *Astarte sulcata* with *A. elliptica* and *A. fusca* or *incrassata*. The last named in each case I regard as the southern form, and the others as the northern form of those three species. Mr. M'Andrew did not find *Pecten septemradiatus* on the Scandinavian coast so large as those of Loch Fyne. A valve from the Faroe banks, dredged by Dr. Carpenter and Professor Wyville Thomson, measures an inch and nine-tenths in length; this far exceeds any I have seen from Loch Fyne, where the species is common. He also says that his specimens of *Astarte sulcata* from Gibraltar and from Finmark are equal in size; and he agrees with me that size diminishes with depth. His dredging-lists record that species from 45 fathoms at Gibraltar and 15–160 fathoms on the western coast of Norway. Possibly his Finmark specimens came from the deepest water, and were consequently smaller than those from Gibraltar. But even if it were not so, my proposition was qualified; and every rule has its exception.

The colour of shells in their living state is, I believe, more affected by temperature than by light; and the former of these conditions must also have a considerable influence on the quantity as well as on the variety of animal life. The cases I instanced of bright hues from deep water were by no means exceptional, and might be supplemented by many more. Indeed, while I am writing, there are on an adjoining table specimens of *Venus ovata* (the shell referred to by Mr. M'Andrew), lately procured by Carpenter and Thomson in the North Sea at depths of 189 and 550 fathoms, the colour of which is, as usual, reddish-brown, some specimens being variegated—also, from 189 fathoms, a bright-red *Tectura fulva* and a pink-rayed *Tellina pusilla*. Milne-Edwards noticed, in the case of the Mediterranean electric-telegraph cable, *Pecten opercularis*, var. *Audouinii*, as "fortement colorée" from between 1010 and 1530 fathoms; and Sars, in his further remarks on the distribution of animal life in the depths of the sea, has now recorded the occurrence of *Pecten septemradiatus*, *Astarte sulcata*, *Natica Montacuti*, and *Eulima bilineata* from 250–300 fathoms, having the same coloured markings as in specimens from shallow water. We do not know the extent to which sea-water is penetrated by the sun's rays; but as cephalophorous mollusks which live at considerable depths are provided with eyes, it may fairly be assumed that light exists there. Carpenter and Thomson got several specimens of *Pleurotoma carinata* in 189 fathoms, and one of *Columbella haliœeti* in 530 fathoms: all these were living, and had conspicuous eyes. In a letter just received from Professor Lovén, he says that, in the last Spitzbergen Expedition, "not a few forms" were brought up from over 2000 fathoms. When the collections have been examined, we shall know something more on this interesting subject.

My proposition founded on the casual occurrence in our seas of exotic and oceanic shells had no reference to the distribution of the Mollusca.

The important explorations of Carpenter and Thomson (which it is hoped will be renewed next year) have produced another addition to the list of recent species which had been called "extinct." A specimen of *Pleurotoma galerita* was dredged about fifty miles from Cape Wrath, at a depth of 189 fathoms. Philippi described and figured this species as a very rare Calabrian fossil.

BIBLIOGRAPHICAL NOTICES.

Geology of Northumberland and Durham, with a Geological Map. By George Tate, F.G.S. (From the Nat. Hist. Trans. of Northumb. and Durham.) 8vo. Newcastle, 1867.

An Essay on the Geology of Cumberland and Westmoreland. By H. A. Nicholson, D.Sc., M.B., F.G.S., &c. 8vo. London, 1868.

The Geological Surveyors of Great Britain have not yet, by far, finished their examination of the northern counties of England, which, though comprising the great coal-field of Newcastle and Durham on the east, and that of Whitehaven on the west, and containing the rich lead-mines of Allendale and the hæmatite-mines of Ulverstone, are for the most part bleak and barren, whether presenting moorlands of sand-rock and limestone in Northumberland and western Durham, or equally barren crags and mountains in the more picturesque Lake-district. These regions, however, have not had less attention from geologists than the more fertile lands to the south, or than the well-worked districts of Scotch geology. Newcastle has had its eminent geologists, and continues to publish the scientific transactions of its naturalists, with successive observations made by good geologists from the Tees to the Tweed. Mr. George Tate's memoir, before us, is one of these well-considered communications, based on the long experience and daily notes of a local observer, to whom every hill and vale, every crag and dene, every stream and loch are familiar, who has watched the changes of the coast, the cuttings of roads, the excavations of quarries, and all the minute but important evidences of geological structure given by wells, by husbandry, by pickaxe and spade, from season to season and year to year. The principal object of this pamphlet (being an introduction to the elaborate memoir entitled "A new Flora of Northumberland and Durham," forming volume ii. of the Nat. Hist. Transact. of Northumb. and Durham) is to supply data to help the botanist to see how far the flora of these two counties is influenced by geological structure; and therefore the mineral characters and range of the various rock-masses are specially treated of; but the history of the rocks, as successive formations characterized by different organisms, is also indicated with clearness, as well as the disturbances they have suffered by subterranean action, accompanied with volcanic rocks, and giving rise to many features of the country. Besides these igneous rocks (such as greenstone and basalt, of Post-carboniferous age, and Postsilurian syenite and porphyry), Mr. G. Tate has to notice:—the superficial peat and gravels, and the older gravels, sands, and boulder-clay of the Glacial period; the probably Triassic sandstones of South Durham; the various members of the Permian group; the rich and interesting Carboniferous formations, namely, Coal-measures, Millstone-grit, Mountain-limestone (in its upper part calcareous, and carbonaceous below), and Tuedian beds (well defined and thus named by Mr. Tate in 1856): the Upper

Old Red Sandstone in patches (with *Adianthoides hibernicus* in Berwickshire and *Sigillaria* (?) in Roxburghshire); and some Cambro-Silurian (Lower Silurian) rocks in the western part of Northumberland. A very neat little geological map, printed in colours, accompanies the paper, and shows (as far as a small scale permits) considerable improvements in detail, compared with other maps of this part of the north of England.

For Cumberland and Westmoreland we have Dr. Nicholson's comprehensive memoir above mentioned, in which are noticed the writings of many others, including the results of some of the work of the Geological Survey in the Lake-district, given by Mr. Hughes in 1866, as well as the fruits of Prof. Harkness's persevering and acute examination of the Lake-district and neighbouring region, often in company with the author himself. Some limited traces of Liassic and Triassic strata in Cumberland are briefly noticed. The next lowest beds of the district are the Permian; and considerable addition to our knowledge of this group has been made by Prof. Harkness, following up Mr. Binney's indications some few years since. Of Carboniferous rocks, there are the Coal-measures of Whitehaven, the sandy beds equivalent to the Millstone-grit, the Yoredale beds, and the Scar limestone; then succeed the Upper Old Red Sandstone and the Silurian rocks, comprising equivalents of the Ludlow beds above, and the Coniston grits, Coniston flags, and Coniston limestone in descending order, and, still lower, the green-slates and porphyries, and the Skiddaw slates, which have been freely traversed by granite and other igneous rocks; whilst the whole have been contorted, dislocated, and most extensively denuded. These rocks and strata are described in detail; the faultings, so important a feature in the structure of the Lake-district, are dwelt upon, especially in the introduction; the characters, features, and effects of the igneous rocks, and the glaciation of some granitic and other masses, are amongst the most important subjects of research.

In the theoretical views of Dr. Nicholson as to the early conditions and changes of the Lake-district, geologists have much to discuss; and we think that our author is hasty in putting aside the late W. Hopkins's views of the geometrical relations of the old faults of this region. The correlation of the older palæozoic beds and fossils of Cumbria with those of Cambria will perhaps long give rise to vexed questions among palæontologists, and certainly will not yet bear dogmatic collocations. Little, however, can be done without good conscientious work, such as that of which this pamphlet is the result. There is no rest for the geologist's hammer, except when the pen is recording or revising its discoveries; so we trust that this essay, at first written as a University thesis, and now published with corrections and additions, will still be amended and enlarged with new work and new results from time to time. It is at present illustrated with several bold sectional diagrams; these will have to be replaced with sections on truer scale and with more accuracy of detail. In the meantime, in its present state, we are sure that

both geologist and tourist will find it a useful book, suggestive of valuable thoughts for the speculative, and of good lines of research for the practical man—helping, in the study, to the memory of former labours in this region, and, in the field, showing where wholesome pleasure may be gleaned in hunting out the history of rock and fossil, of hill and lake, and, indeed, of the world itself.

A Monograph of the Recent British Ostracoda. By George Stewardson Brady, Esq. (Trans. Linn. Soc. vol. xxvi.)

The whole of the last-issued Part of the Linnean Transactions is occupied by the monograph which we are about to notice, and which extends to 143 pages, illustrated by nineteen plates.

We have here a most valuable contribution to the history and elucidation of the Ostracoda. The study of this section of the Crustacea has, both on the Continent and in the British Islands, been recently attracting much greater notice, and, we venture to prophecy, is destined to occupy a much larger share of the attention both of zoologists and geologists than it has hitherto done. This is the only order of the Crustacea the remains of which have been found fossil throughout a long series of beds in considerable abundance; and they are likely, when more diligently searched for, hereafter to render important service in assisting the geologist in the classification and sequence of strata. They present certain advantages for this purpose over the Mollusca and other larger organisms, because the small and generally strong valves of their minute carapaces will often escape destruction when it fares badly with their larger brethren. For example, glacial action, which will grind to pieces all univalve and bivalve shells, may be expected to leave unharmed the *Cythere* or the *Bairdia*—just in the same way as while we crush the snail to atoms under our foot, the little ant which was there at the same time, so far from objecting to the operation, turns smacking his lips to the dainty morsel which we leave him to enjoy. A more careful washing of glacial clays and attentive search for the Ostracoda which they may contain will be found no unimportant step in the determination of the circumstances under which a particular bed was deposited, as showing whether it owes its origin to subaërial or true glacial ice, or was a submarine or icebergal deposit. Indeed, so abundant are fossil specimens, that with our present workers in the field, Messrs. Brady, Norman, Robertson, &c. collecting the recent forms, and Messrs. Crosskey, Robertson, &c. the Tertiary and, more especially, Quaternary forms, it has become a mere toss-up whether a species shall first be found fossil and then recent, or *vice versâ*. Of the species described by Mr. Brady, no less than fifty-six marine and six freshwater species have already been met with fossil in the glacial and other more recent deposits; and what makes this the more striking, as showing how completely this study is even now in its infancy, is the fact that no less than forty-three out of the fifty-six marine species referred to, and which are

now known as fossil, lived unnoticed in our seas until the last five years; and, indeed, a considerable number of them are for the first time recorded in this monograph.

Acquaintance with freshwater species of Ostracoda dates back to the middle of the last century. The investigation of the species has been gradual and continuous; and at the present time we are tolerably conversant with those members of the order which inhabit the streams, lakes, and ponds both of the British Islands and of continental Europe; but with the marine species the case has been different. It was in 1785 that O. F. Müller first recorded the existence of sea forms, and in his 'Entomostraca' established the genus *Cythere* and described five species. There the matter stood, without any fresh light being thrown upon the subject, until Dr. Baird, in 1837, published six additional species in the 'Mag. of Zool. and Botany.' In the following year M.-Edwards established the genus *Cypridina*, containing a single species. From that time until 1850, when Dr. Baird published his 'History of the British Entomostraca,' matters were at a standstill. That work made us acquainted with seven more *Cytherœ* (together with a freshwater form which was assigned to that genus), with three species of recent *Cythereis*, and with two *Cypridinæ*. The 'List of the British Marine Invertebrate Fauna,' published by the British Association eleven years subsequently (1861),only contains two additional species,*Cypridina Mariæ* and *C. interpuncta*, which had been published by Dr. Baird. In that year the Rev. A. M. Norman described a fifth British *Cypridina*, and recorded the *Philomedes longicornis* of Lilljeborg from Plymouth in the 'Annals of Natural History.' In the following year he added five *Cytherœ* and a *Cythereis* in the same journal; and in 1864 (Nat. Hist. Trans. Northumberland and Durham) eight more *Cytherœ* and another *Cythereis*. Lastly, in the 'Report Brit. Assoc.' 1866, Mr. Brady characterized nine additional marine species from the Hebrides, distributing them in the genera which had just been established by G. O. Sars. Thus, when Mr. Brady commenced his monograph, there were (deducting species proved to be synonymous) forty-four marine Ostracoda described, and twenty more of which the names had been recorded in his paper just referred to.

On the Continent the marine Ostracoda had, until quite recently, been wholly neglected. Since Müller's time, beyond a *Cypridina* noticed from the Mediterranean by Costa and Philippi, and two Norwegian species (which, however, are synonymous with previously described British forms), no additions had been made to the fauna. In 1865, however, G. O. Sars published, in the 'Vid.-Selskabets Förhandlingar,' his "Oversigt af Norges marine Ostracoder," a monograph which at once placed the study of this order of animals on a new footing. He had not only collected seventy-seven species in the Scandinavian seas, but, with the greatest skill and anatomical research, so investigated their structure and anatomy that he was able to establish a large number of genera upon what would seem to be valid and sound characters.

Taking Sars's 'Oversigt' as the basis of his work, Mr. Brady has,

in the monograph before us, fully elucidated the animal as well as the shell of the species he describes; and, carrying still further the system of classification inaugurated by the Norwegian naturalist, he presents us with a history of one hundred and forty-one species, distributed in twenty-eight genera—certainly an extraordinary advance upon the forty species and five genera which represented the state of our knowledge of this order at the time of the publication of 'The Natural History of the British Entomostraca.'

The work before us shows evidence of the greatest care in preparation and in execution. The descriptions of both shells and animals (the latter given in a large number of instances) are systematically and well drawn up, while the beauty of the plates leaves nothing to desire. They represent the carapace of each species in its various positions, and fully illustrate the anatomy of the genera. Both zoologists and geologists may thank the Linnean Society for the publication of this extensive and important monograph.

MISCELLANEOUS.

On the Habits of the Volutes. By Dr. R. O. Cunningham.

Valparaiso, Oct. 9, 1868.

My dear Sir,—In the April number of the 'Annals and Magazine of Natural History,' which I received not long since, I find at p. 310 a note by you on the habits of Volutes, in which you remark that they are rarely collected with their animals, except when they are accidentally thrown ashore after a storm, and that this is owing to their sand-burrowing propensities. This I have found to be the case as regards the species of the genus inhabiting the Strait of Magellan. During the first season I spent in that region, I only succeeded in procuring two live specimens of *Voluta magellanica*, till the occurrence of a violent easterly gale caused numbers to be thrown on the beach in the neighbourhood of the Chilian settlement at Punta Arena. That they only existed in comparatively shallow water I considered sufficiently proved by the fact that I never succeeded in dredging any, though they were evidently far from rare, judging from the numbers of dead shells to be picked up in most localities in the eastern part of the Strait. I obtained a second species of Volute, of which there are no specimens in the collection of Magellanic shells in the Museum at Santiago, at low water at Cape Possession in January 1867. I found it burrowing in considerable numbers in the fine sand of the beach; and a few occurred upon clusters of live *Mytili* attached to stones, and, I believe, were feeding on them after the fashion of our *Purpura lapillus*, though I could not be certain of the fact. The body of the animal in

this species, which was of a most beautiful purple colour, was always very much extruded from the shell, and the foot was of enormous size. The animal of *Voluta magellanica* is also purple, but of a much paler tint than that of the other Volute. I regret I was unable to make drawings of the animals while alive; but numerous specimens of both species were included in the collection of marine animals in spirit which I sent to the British Museum last year.

Believe me,
My dear Sir,
Very truly yours,
Robert O. Cunningham.

Dr. J. E. Gray, F.R.S.

A mature Shell of Cypræa fusco-dentata, *Gray.*

By F. P. Marrat.

Mr. R. Keen, of Edge Lane, Liverpool, has recently procured a very interesting series of this shell, numbering nine or ten varieties; they fully exhibit the different stages of growth, from the earlier states to the finely coloured adult individual. The question formerly advanced of this being a ribbed species resembling *Cypræa capensis*, Gray, is now completely and definitely settled. All the specimens hitherto obtained of this rare shell have been either young or decorticated; and it would appear that the species is extremely rare in a perfect state. This series includes the first and only example known to be so.

The shell is a very fine one, measuring $1\frac{6}{10}$ inch, with the teeth fully developed. The colour is dirty drab, similar to the shells usually figured; but the back is covered with rufous-brown close spots like those on *Cyp. errones*, Linn., and nearly as glossy, but has them larger, more confluent, and more suffused. The slightly raised ribs usually seen in young examples are not entirely obliterated by having the extra coat of enamel deposited over them.

100 Edge Lane, Liverpool.

Baleine des Indes.

Under the above name there are manufactured and sold in Germany (and these have been offered for sale in London) longitudinal slips of the horn of the Long-horned Buffalo of India, called the *Arnee*. The slips are cut of different thickness and width to serve the purposes of the stay- and dressmakers, the longest as yet made being only 15 inches. I fear that the slips must be much more brittle than good whalebone, as they are destitute of the longitudinal fibres that give strength to the true whalebone. If they do answer, I do not see why the slips might not be made of any length, the horns being artificially united together into a mass, as the ox-horns are in Paris, to make sticks and other articles.—J. E. Gray.

Double Eggs.

To the Editors of the Annals and Magazine of Natural History.

Gentlemen,—Capt. Mitchell's notice of "a double egg of a fowl," in the 'Annals' for last month, has brought to my recollection the following account of a double egg I heard at the small village of Bantham, near the Bolt-Tail, on the south coast of Devon, this summer. Several farmers met in the common room of a small inn, when one of them asked "if any on 'em there could tell the weight of a guse's egg?" Several statements were made, but eight or nine ounces appeared to meet with the most approval; but one man said, "Now I reckon you had one wi' a double yolk, so I do say eighteen ounces." "Thee beest nigh the mark, for 't were nineteen ounces; but 'twarn't a double yolk, at least not a double yolk like most double yolks be; for when I broke the shell, there comed out, oh! a lot o' stinking trade sure 'nough; but when all that beastliness were out, why I'm blessed if there warn't a proper egg inside, quite gude. 'Twere the largest egg I ever see'd in my life, and he 'most killed the ould guse for to lay en; her never laid no eggs afterwards, her didn't."

I give the story in the farmer's own words, because, although I believe the account, I have it only on hearsay.

I am, Gentlemen,
Yours obediently,

Plymouth, Nov. 18, 1868. C. Spence Bate.

Occurrence of Gigartina pistillata *on the Welsh Coast.*

Mrs. Gatty, in the month of September, 1865, picked up a specimen of *Gigartina pistillata* in fruit, in Blackpool Bay, not far from Linney Head, on the south-western coast of Pembrokeshire. It was seen by Dr. Harvey, at New Milford, on his way to Ireland; and he had a written account of its discovery made out for the Trinity College herbarium (Dublin).

Palu.

Some time ago a very small quantity of a fine silky substance was brought to England from California under the above name; and it was used as an object for the microscope, on account of its beautiful structure. Mr. Bingham, in his very interesting paper on the "Volcanic Phenomena of the Hawaiian Islands," says—"*Palu* is the silky covering of the opening fronds of several species of tree ferns, and is exported in large quantities to California, for beds &c." (p. 426). The trade is so extensive that "corduroy roads" are made to the station where it is collected, and whole districts are leased for the "*Palu* business," and there is a large number of "*Palu*-pickers." The *Palu* is collected at Kelauéa, which is the most tropical region in Hawaii; the tree ferns have stems 15 feet high to the base of the frond, and 8 or 12 inches in diameter.

On Myomorphus cubensis, *a new Subgenus of* Megalonyx.

By M. Pomel.

The subject of this note is a mandible, almost reduced to its dentary portion, which was among the objects sent to the French Exhibition of 1867 by M. Fernando de Castro. It was found in some excavations at the baths of Ciego-Montero, and given by Don José Figueroa. From the analogy of the matrix, the author associates with it some plates of tortoises and the posterior part of the mandible of a crocodile, probably allied to the alligators. The bed is probably of quaternary age.

The mandible has the characters of *Megalonyx*, and the same dental formula—three teeth in a row, and a fourth isolated in front. The molars of the series are prismatic, with a long root, slightly arched, the concavity being turned backward; they are nearly triangular, with the angles, especially the inner one, blunt and rounded. The outer side, which is shortest, is a little depressed in the middle; the anterior side is nearly straight, and the posterior very convex, rounded especially towards the inner angle, which is the thickest. The first of these teeth has the outer side a little oblique; the second is of nearly the same size and form, but its outer side is parallel to the alveolar line: the diameters of their crowns are as 16:21. The third has its two diameters equal, in consequence of the widening of the outer surface; and its postero-interior side forms a portion of a cylinder.

The crown is convex, with anterior and posterior ridges produced by two transverse crests of very hard dentine, playing the part of enamel. In their minute structure, these teeth show five very distinct concentric zones, divisible into two groups of analogous substance. The outer zone is a pellicle of very dense substance, traversed by a few canals, and shining at its surface like enamel. The second zone consists of a substance like ivory, with its transverse fracture grained and reticulated by canals ascending obliquely inwards. This substance seems to be of the same nature as the outer pellicle, but to have more numerous canals and less density. It is the cement of many authors; but, unlike the cement of the teeth of the Ungulata, it has much more analogy with that of the bones, and may be named *eburnoid*. This zone forms the outer slopes of the ridges of the crown, where it is about 2 millimetres thick; it becomes suddenly thin, in order to follow the outer and inner margins.

The third zone is formed by a very hard dentine, of fibrous appearance, but really finely transversely vascular. This forms the crests of the coronal ridges, where it shows a thickness of $\frac{1}{2}$ millimetre, and becomes gradually thinner on each side. The fourth zone only differs from this in its less hardness and its duller aspect, due, no doubt, to a coarser vascularity. It occupies the inner slopes of the ridges, and, like the eburnoid substance, which it equals in thickness, becomes much attenuated at the inside and outside, until it becomes scarcely discernible. In its broader part it seems to form fine concentric layers. These two zones constitute the hard

dentine of odontologists. The fifth zone, forming the axis of the tooth and the bottom of the coronal hollow, is the softest of all; it is the vascular dentine of authors. Its apparently fibrous structure is more loosely vascular than that of the hard dentine; its ascending canals become more and more oblique towards the crown. The diminution of the four outer zones towards the inner and outer margins causes a greater extension of the vascular dentine in these directions; and this arrangement explains why the coronal hollow opens outwardly.

These teeth have no rootlets, unless late in life. The part first organized seems to be the zone of hardest or enamel-like dentine; but the eburnoid substance seems to be nearly coincident in its formation.

The first tooth is separated from the others by a rather wide gap, and thrown nearly to the margin of the mandible, where it somewhat resembles a very broad incisor of a rodent; its transverse section is crescentiform, with the horns blunt and rounded off, and the concavity behind. The bone of the mandible is produced a very little beyond this tooth, in the form of a very short beak, channelled beneath. The two diameters of the tooth are as 10 : 22. It has a pellicle of false enamel; but the whole interior of the tooth is formed by a compact homogeneous substance, not unlike the ivory of the hippopotamus. It shows no trace of vascularity. An arched line in its middle seems to indicate a band of a different and perhaps softer nature.

The mandibular bone is remarkable for the parallelism of the two dental margins and the narrowness of the interval separating them, the depth of its ramus beneath the molars, the strong convexity of the lower margin beneath this same point, the great extent of the symphysis, and the very oblique elevation of the anterior margin towards the terminal beak. Except in these and some other details, the bone closely resembles its homologue in *Megalonyx Jeffersoni*.

The differences of the dental system in this animal and *Megalonyx* are as great as those by which the genera *Mylodon*, *Scelidotherium*, and *Gnathopsis* are distinguished. The serial molars in *Megalonyx* are nearly equal and subquadrangular; in the present animal they are rather triangular, and the last is distinctly the largest. The isolated tooth in *Megalonyx* is very oblique, and has an elliptical section, whilst in the Cuban fossil it is more arched in the direction of its length, and much more like an incisor. This character is of great importance, and might seem to be an advance towards the dentition of *Tylotherium* (*Mesotherium*, Serr.), if the similar tooth in the latter did not appear to be a true incisor. The rest of the skeleton will no doubt furnish further characters: for the present, the author forms for this animal a new subgeneric section, to which he gives the name of *Myomorphus*; and the species may be called *Megalonyx* (or *Myomorphus*) *cubensis*. The author gives the following measurements as compared with those of *Megalonyx*:—

	Myomorphus.	*Megalonyx.*
Length of dentary ramus from the last molar to the anterior margin	115 mill.	150 mill.
Space occupied by the three serial teeth	63 „	60 „
Length of the bar	30 „	40 „
Depth of the dentary ramus below the serial molars	70 „	100 „
Interior separation of the two rami towards the last molar	18 „	18 „

—*Comptes Rendus*, tome lxvii. September 28, 1868, pp. 665–668.

On Capillary Vascular Systems in the Gasteropoda.
By Professor C. Wedl.

The theory proposed by Milne-Edwards, that in the Mollusca the arterial and venous systems are not united by a capillary system, but that a system of lacunæ destitute of proper walls intervenes between them, is not confirmed in the Gasteropoda investigated by the author. In *Helix*, *Limax*, *Turbo*, *Lymnæus*, and *Murex* he has ascertained the existence of closed capillary systems, with proper walls and characteristic of the different organs; these may be displayed by injection either from the arterial or the venous side. The existence of a lacunar system must be denied even in the respiratory organs. Nor could he convince himself that the vascular system is open either towards the cavity of the body or the outer surface. Hence the theory of the imperfect circulation of the blood in the Gasteropoda is at least not of universal application.—*Anzeige der Akad. der Wiss. in Wien*, July 23, 1868, p. 179.

On some new Fossil Fish from the Lias of Lyme Regis.
By Sir Philip de M. Grey Egerton, Bart., M.P., F.R.S., F.G.S.

1. *Osteorachis macrocephalus*, gen. et spec. nov.—A Sauroid fish, chiefly remarkable for the massive dimensions and complete ossification of the bodies of the vertebræ, and characterized by the large size of the head and the multiplicity of the teeth.

2. *Isocolum granulatum*, gen. et spec. nov.—For elegance of form this fish can vie with the salmon of modern times, its contour being very similar. It bears the greatest resemblance to the Sauroid genus *Caturus*, but in the absence of the teeth it cannot be assigned with certainty to any particular family.

3. *Holophagus gulo*, spec. nov.—A cœlacanth fish, remarkable for its resemblance, especially in the contour of the head, to the Cretaceous genus *Macropoma*, and for substantiating Prof. Huxley's demonstration of the persistence of type presented by this family, which ranged from the Coal-measures to the Chalk.

4. *Eulepidotus sauroides*, gen. et spec. nov.—This first represents a genus uniting the Lepidoid and Sauroid families of Agassiz's Ganoid order; the teeth and the tail being Sauroid in character, while the fins are Lepidoid, and the scales partake of the characters of those structures in both families.—*Proc. Geol. Soc.* June 17, 1868.

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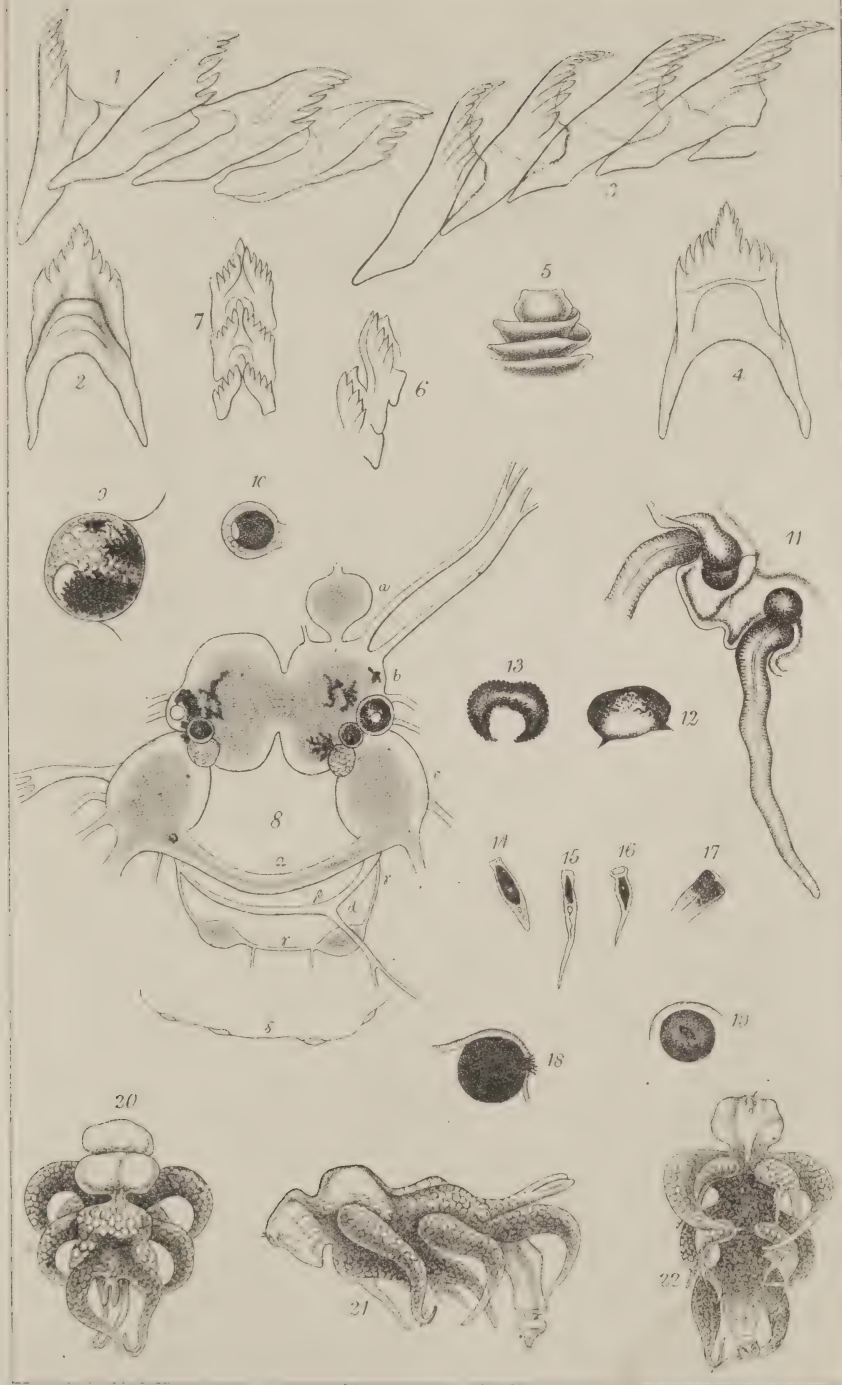
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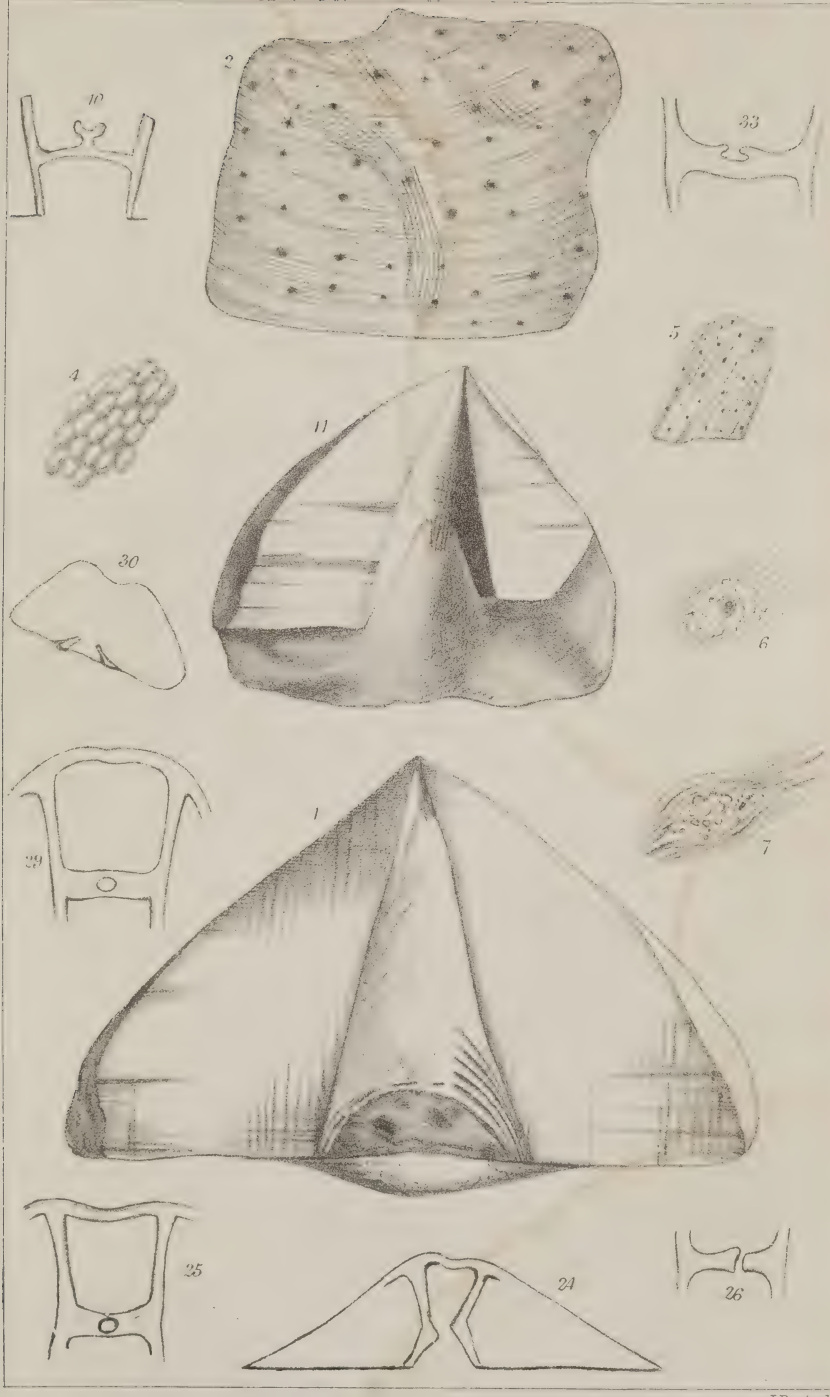
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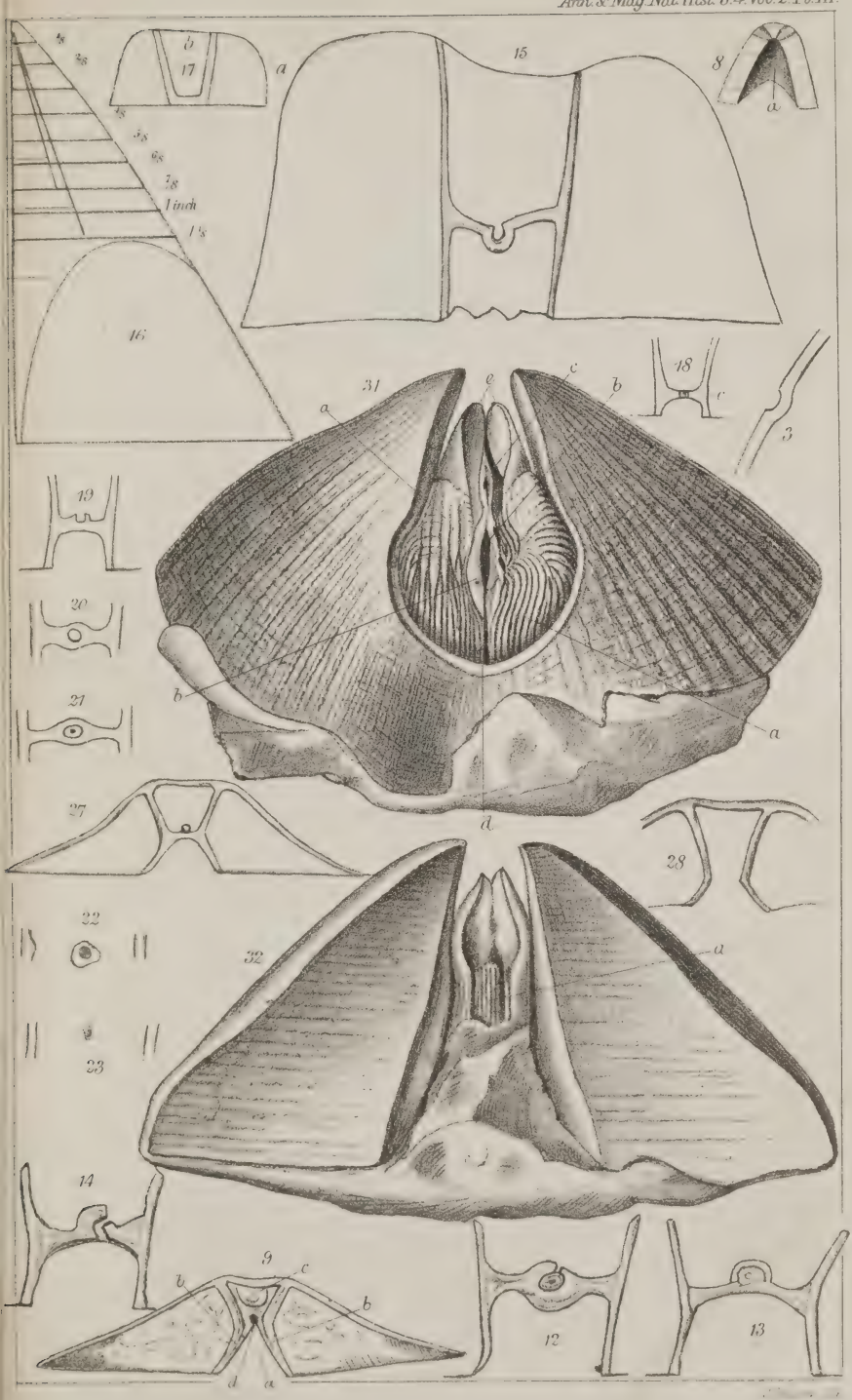


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G. S. Brady del. et lith.

W. West imp.

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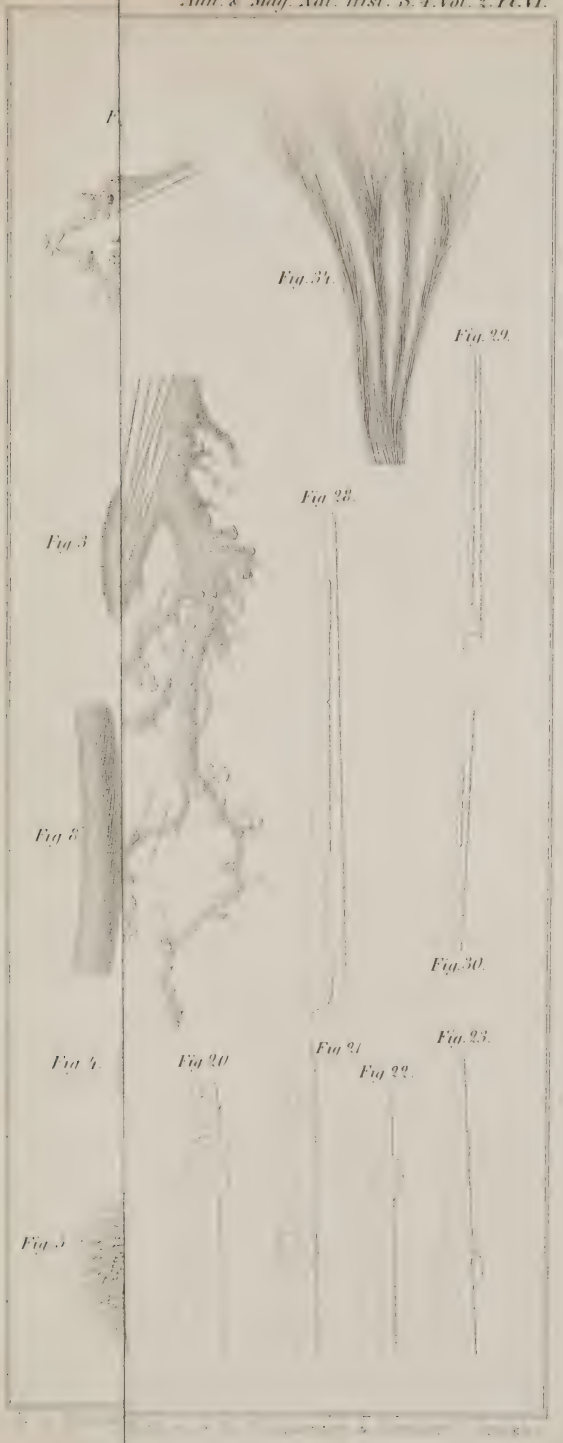

Fig. 34.
Fig. 29.
Fig. 28.
Fig. 3
Fig. 6
Fig. 30.
Fig. 4.
Fig. 20
Fig. 21
Fig. 22.
Fig. 23.
Fig. 5

Fig. 36

Fig. 2

Fig. 31.

Fig. 33.

Fig. 38.

Fig. 34.

Fig. 29.

Fig. 35

a

Fig. 32

Fig. 3

Fig. 1 a

Fig. 13.

Fig. 28.

Fig. 18

Fig. 31.

Fig. 8

Fig. 7

Fig. 24

Fig. 10

Fig. 11

Fig. 30

Fig. 9

Fig. 12

Fig. 19

Fig. 17.

Fig. 21

Fig. 23

Fig. 4

Fig. 6

Fig. 14

Fig. 15.

Fig. 16.

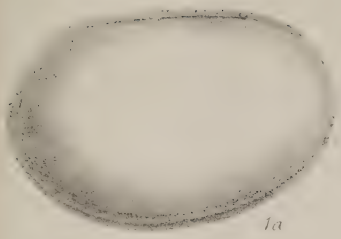
Fig. 20

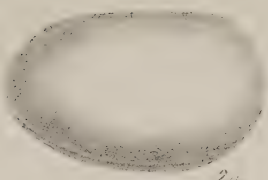
Fig. 22

Fig. 26

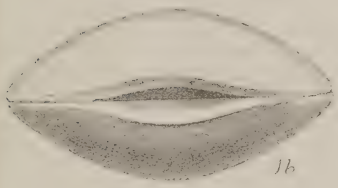
Fig. 25

Fig. 5


1a


2a

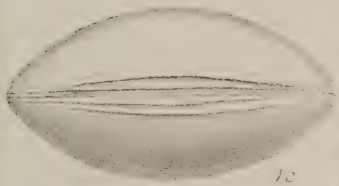

3a


1b


2b

3b


1c


1c


5a

5b


5a


6a


7a


7b


7b

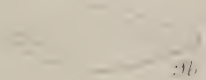
8b


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Silurian Entomostraca.

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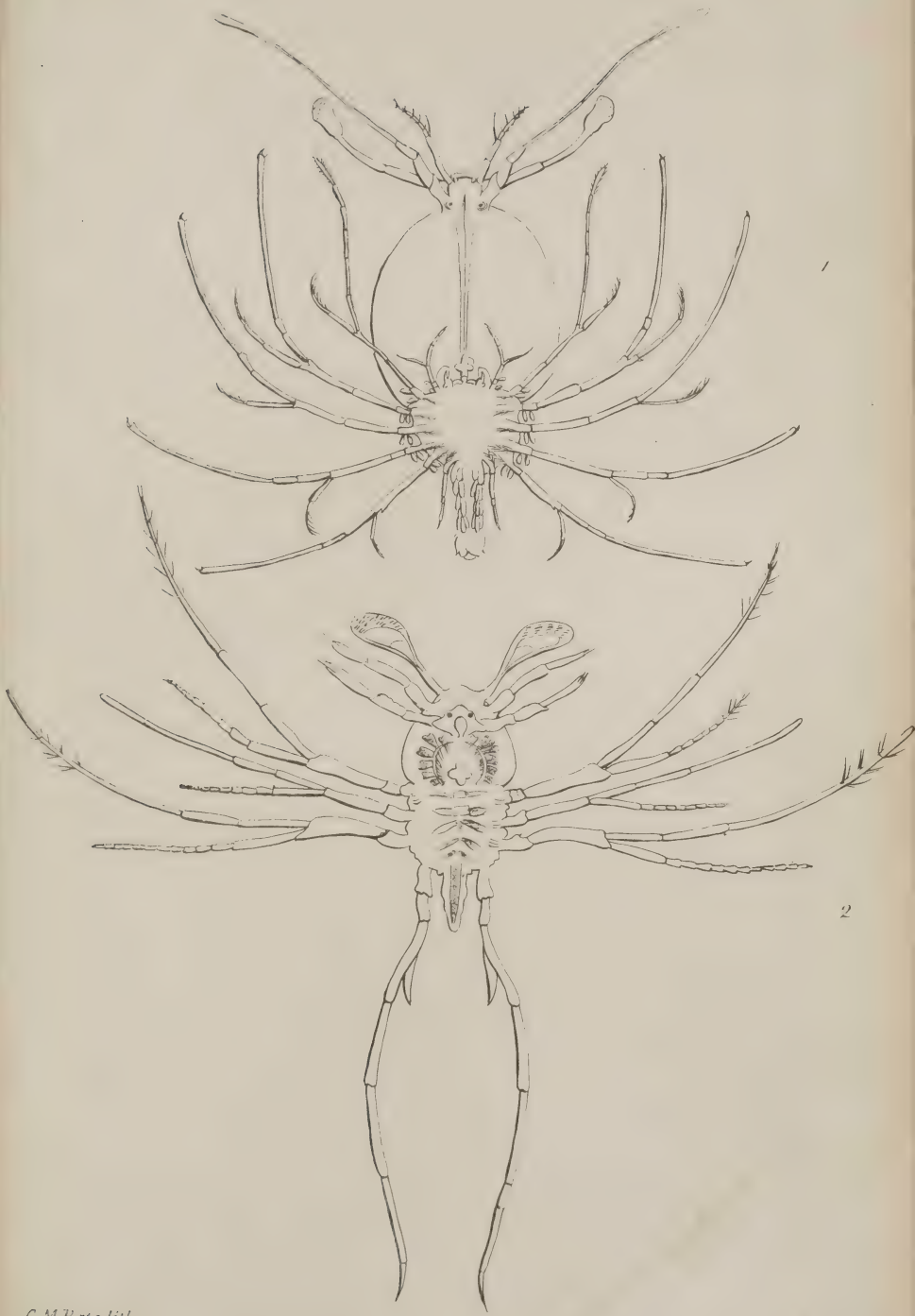

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1 *Agrilus ignicollis*
2 " *Saundersii*
3 *Mychommatus cyaneus*
4 *Belionota Championi*
5 *Orsocerus Murrayi*
6 *Chrysoderma chrysochlora*
7 *Psiloptera piperata*

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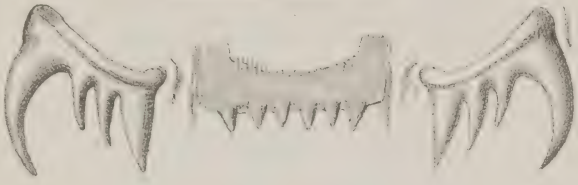


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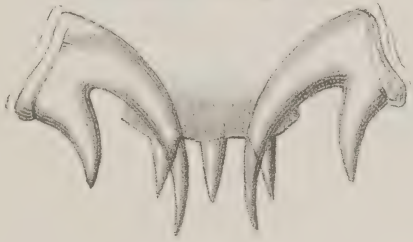
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Buccinum undatum.



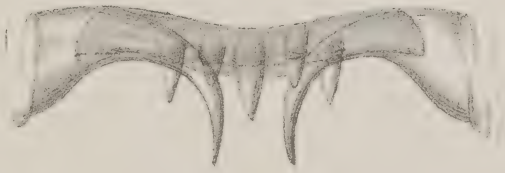
2.

Cassidularia melongena



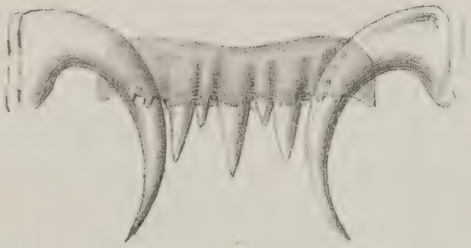
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Murex tenuispina.

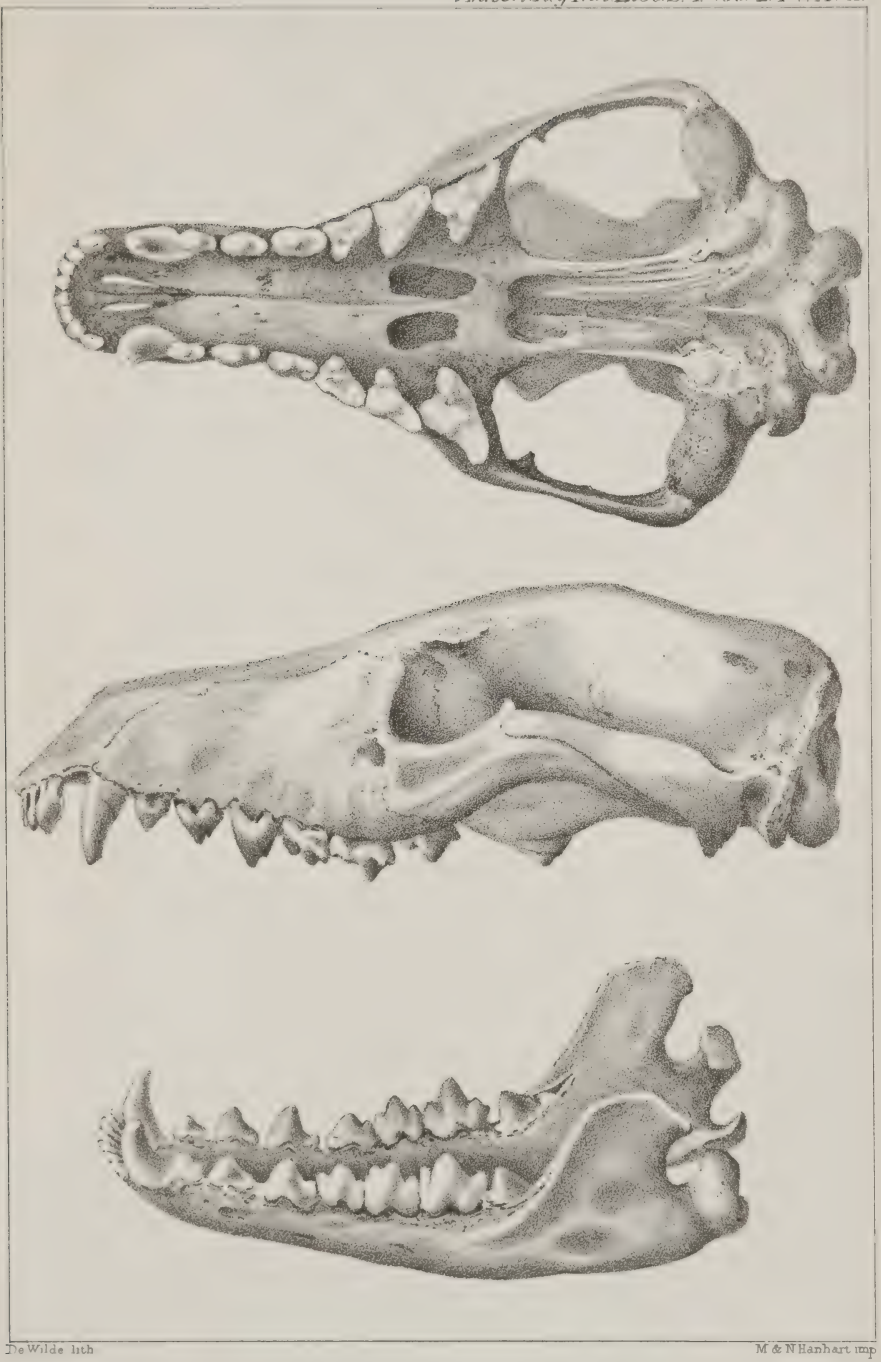


4.

Conchelepas peruvianus.



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M & N Hanhart imp

THYLACINUS BREVICEPS. *Krefft.*

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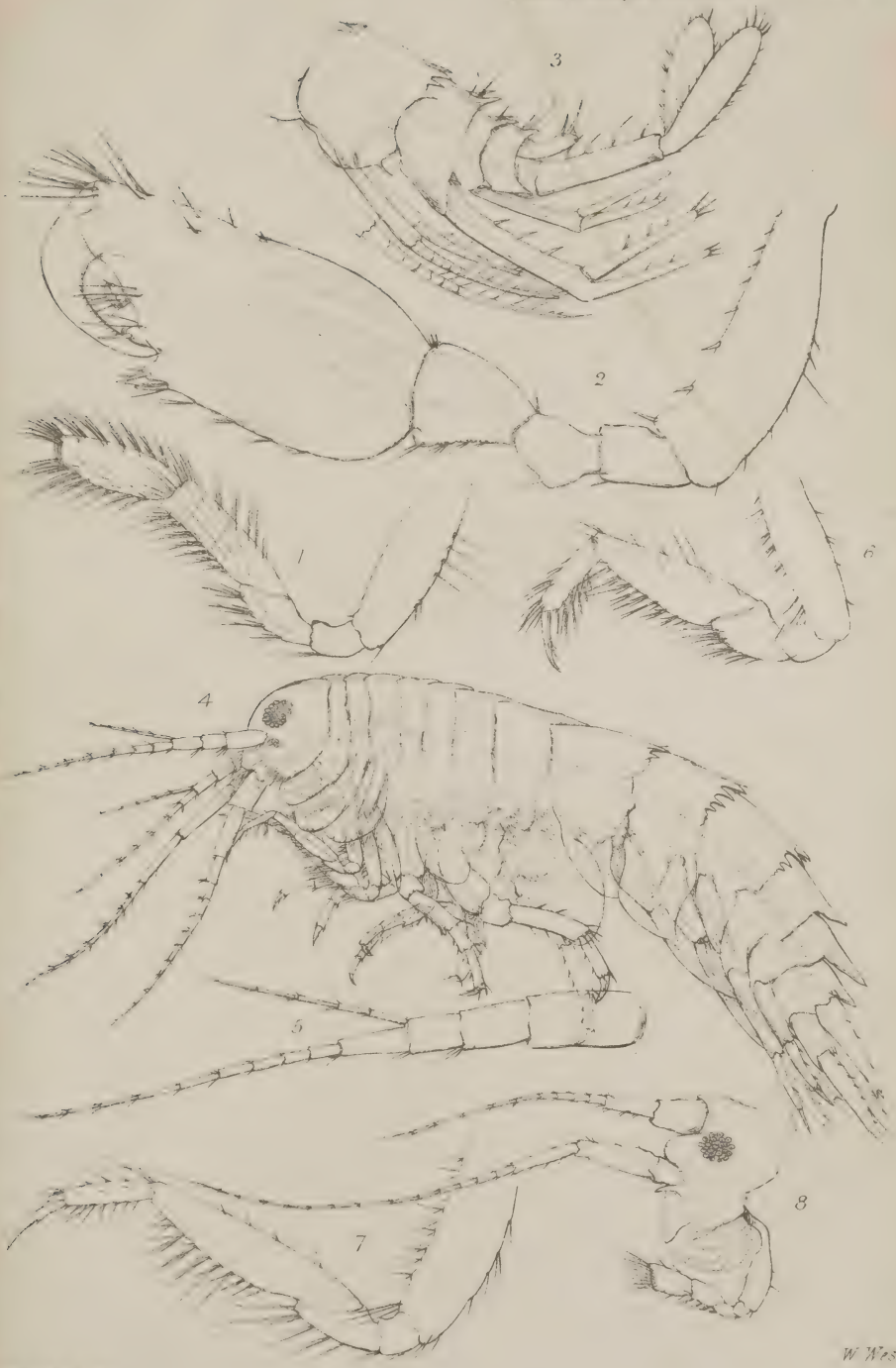
Fig. 1 R. Mott W.C. M del. Tuffen West sc.

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